Telling the market story through Organic Information Interaction Design and IP broadcast media

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Submitted by

James Alex Harvey

Approved by

Supervisors: Roy Parkhurst, Julie Fairless

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1. Introduction

> *Interaction Design, which is essentially story-creating and telling, is at once both and ancient art and a new technology. Media have always effected the telling of stories and the creation of experiences.*
> *(Shedroff, N., 1994, p. 2)*

Advances with visual representations within broadcast design have been applied to areas such as weather simulations, sporting events, and historical reconstruction's. However, financial market information presentation is fairly uniform in television news broadcasting, showing little progression in pace with other news information categories.

While stock market news segments make limited use of supporting graphics, additional information that may assist the viewer is filtered out, effecting viewers interest, understanding and decision making process often associated with market related stories.

Research to date has been limited to single visualisations. There has been little research into the use of multiple information views that are composed to support news presentations.

People use many different information sources on a daily basis. News sources are used to stay informed about events, to some sources, viewer evaluation of information is a part of that process. News information and other data commodity sources are now more accessible, allowing designers to look at ways of transforming them into new or improved information services.

This research explores the display of stock market information by looking at appropriate media delivery methods combined with Organic Information Interaction Design to enhance information relationships. Organic Design and Information Interaction Design[1] principles are combined. This denotes a 'living' relationship between elements, incorporating hierarchy principles with enhanced information delivery and user experiences. Four themes are tied together through the use of a conceptual prototype.

1 See Information Interaction Design refer to *Information Interaction Design: A Unified Field Theory of Design*, (Shedroff, N., 1994)

1.1 Relevance of Visual Story Telling to Financial Markets

While existing market reporting may use few disjointed information graphics combined with market stories and reports, 'organic' methods for traversing information, combined with Information Interaction Design and motion graphic techniques, can improve visual storytelling. Market graphics are essential in providing additional support to stories, however, relationships to related information need to be improved. This research investigates the practicality of using visual storytelling in financial market news via broadcasting media to better inform viewers of market events. An overriding principal is that this information would then be utilised by the viewers to then act upon the information received as desired; such as whether to trade, hold, or continue to watch etc.

1.2 Relevance of Broadcast News as Delivery Channel

Media delivery is taking advantage of more open syndication formats using web based technology. The convergence of internet and IP (Internet Protocol) with traditional network delivery makes viable new broadcast media channels possible for content delivery. Technologies such as IPTV (Internet Protocol Television), streaming, mobile network deliveries are looked at; these things ensure that access to content is virtually 'always on', thereby providing the viewer the opportunity to act and react to market events real-time (or at some point later if required).

1.3 Data Transformation Methodology

While traditionally, market data accessibility was limited, large amounts of quantitative information are available to drive data graphics, these sources are left largely unused to support such presentations. The viewer is now able to receive masses of data, from source, rapidly and in real-time. To assist the viewer from suffering 'information overload', this research establishes a methodology for transforming raw financial data into meaningful information, and then confirms a set of design interface principles for representation to the viewer. In addition, not only displaying information in better ways is required, but the effects that information may have in supporting viewers decision making is also of importance.

1.4 Information Interface Design Principles and Assessment Prototype

Existing linear market presentations provide little opportunity for presenter engagement with little or no flexibility to work with different scenarios. Based on the re-

view of information design research, a working prototype interface was developed to test the relevance of a set of Organic Information Interface Design Principles. Refinement of the original design through prototype iterations has shown that 'valuable' Stock Market information, delivered via broadcast media, can be based around a set of key attributes: simplicity, information relevance (to viewers), clearly defined metrics, drill down capability and metric context, links to individual viewers context and graphical layouts including colour and location characteristics.

Of equal value to the establishment of Information Interface Design principles, a set of pitfalls was encountered through examination of traditional financial markets news broadcasts (such as Television New Zealand; TV One, TV3 New Zealand) and testing of the prototype, undertaken by a viewer 'test group'. Difficulties ranged from a numeric (data) view, measures that didn't matter, lack of standards, over-reliance on tools, lack of drill-down capability, and no individual effect.

1.5 Detailed Research Approach and Method

Existing discourse on the use of design within financial based matters is often limited and largely carried out by those within business or computer science disciplines. This research provides design discourse within the specific topic of information design and visualisation of financial topics. Financial information representations and 'stereotypical' displays, in-particular those related to Stock Market information and related news, have been analysed.

This research identifies the perceived 'problem' with market broadcast graphics, and how design as a response can improve viewer understanding through the use of new gestural interaction interface display technology.

The research approach aims to:

1. **Determine Historical and Existing Background** – Research to understand the history, common design principles, and changes within the financial news broadcast standards.

2. **Examine Contextual Information**[2] – Through research understand the current news broadcasts by content analysis with focus almost exclusively on tracking operational market performance metrics. This is aimed at showing primarily one-off 'point in time' information. The Information Design developed is focused on tracking the movements of market performance over time, to provide context, and meaning to the viewer.

3. **Understand Audience and Key Contributors**[3] – Philosophy and thinking from leaders in their field (such as McLuhan, Tufte, and Roberts) are examined in the fields of Information Design, graphic design and market intelligence realms. Behavioural aspects of the end information viewers are explored and validated by online observations.

4. **Evaluate Media Reporting and Delivery** – Investigation into trends, emerging technologies, and innovations relevant to network delivery models (such as IPTV, Internet TV, Mobile TV) using similar presentation methods to existing broadcast news segments.

5. **Build a Set of Design Principles** – Interface Design and Financial Market Information Design principles are initially established, investigated, and defined. Central to the approach, is the determination of relationships to interactions between data and Organic Information Interaction Design Principles.

6. **Establish Communication Improvements** – A set of Organic Information Interaction Design Principles is developed (drawing from both the interface and financial design principles described above). The consolidated principles form the basis of the working prototype. To provide a better response, improved design methods are derived to support improved clarity and understanding in the minds

2 Refer to appendix items - Fig. 55, 56, 57 & 58.

3 Also refer to appendix item - Fig. 55.

of viewers, who may become lost or overwhelmed among growing information sources.

7. **Develop Conceptual Prototype** – Develop a design prototype, complete with user-interfaces (screens), navigation, drill down capability, user invoked interaction (such as gestured interaction) and framework for potential AI (Artificial Intelligence) based interpretations. This prototype aims to improve the transitional summary views associated with Stock Market information and build upon existing 'mental models' which would also support information comparisons. It is not necessarily seen as an opportunity to discard 'mental models' altogether, but to create new improved design iterations with fresh insight.

8. **Test & Evaluate Prototype Against Principles** – Use the Prototype to test for stock variation and evaluate the applicability of the Organic Information Interaction Design Principals via viewer response. A series of scenarios is developed that led the test group to a response (e.g., buy, sell, hold). The design response for this research is seen to offer a significant design iteration on Stock Market media reports and information displays. To achieve this; the evaluation of the information relationships is tested to support the design response.

9. **Conclusion** – Build conclusions and determine relevance. The Organic Design specific to Stock Market information is summarised by a conceptual prototype, supported via live data and information feeds. Exploration into potential usage and implementation supports these additional recommendations. The four themes of the research are evaluated:

- Relevance of storytelling to financial market
- Relevance of IP broadcast news as a delivery channel
- Data transformation methodology
- Design principles

Approach Diagram

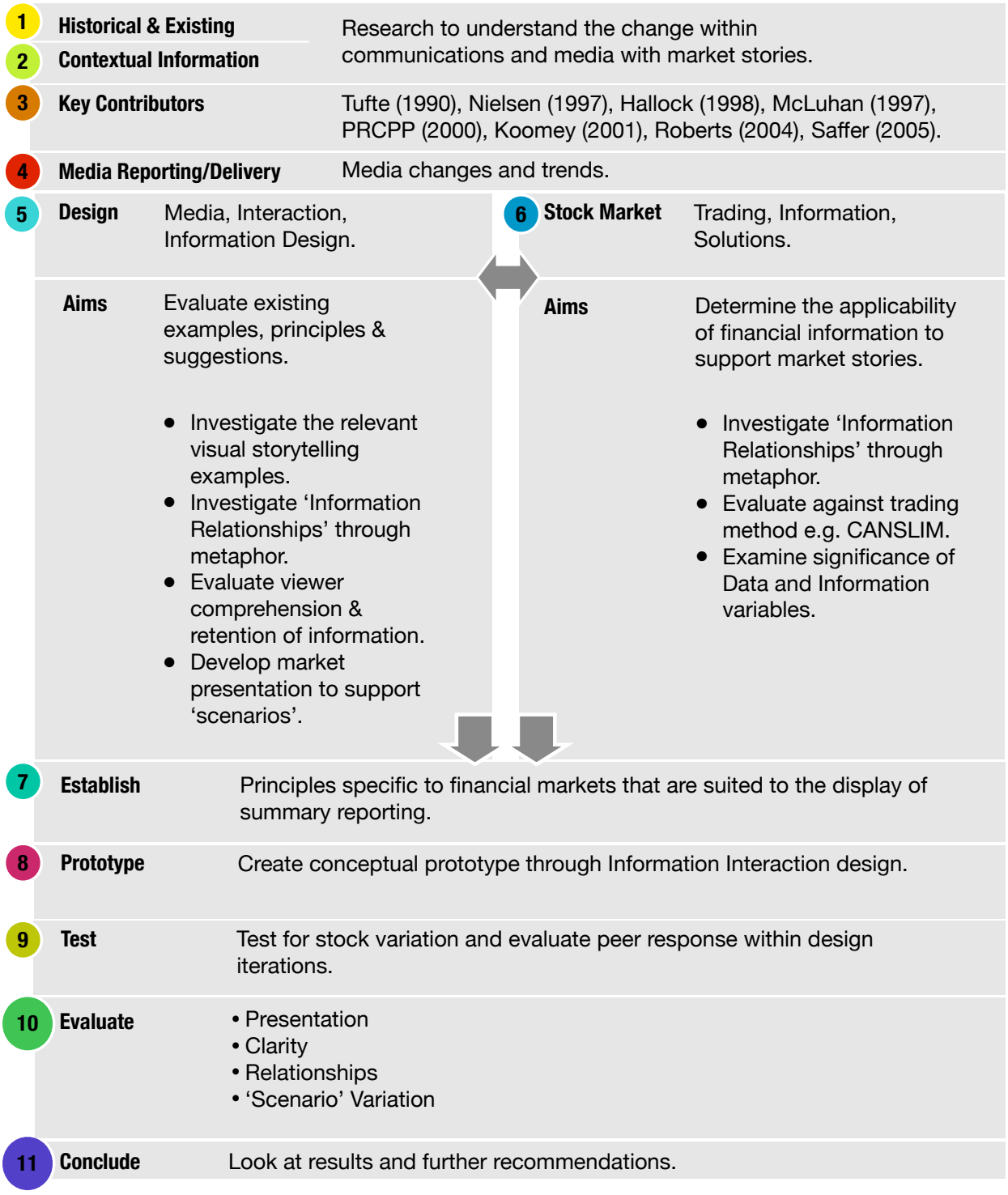

Fig. 1. Shows research process and other relevant points for discussion.

1.1 Financial Markets

It is from a media perspective that this research investigates the accessibility and delivery of financial information. In 1974, communications theorist Marshall McLuhan, provided insights and observations on the changing face of media, global travel, and instantaneous communications (McLuhan, M, p. 46, *'Making Contact with Marshall McLuhan'*, interview by Louis Forsdale, 1974). These observations became influences affecting change within the global economy. People stay informed about the constant change within financial markets stretching across different time zones. It is a complex subject because of many influencing factors. Those who invest or trade within the markets, hone their skills with sourcing relevant up to date information.

The Hunter-gatherer

Basic activity of trading dates from the first hunter-gathers up to the end of the Palaeolithic period some 12,000 years ago (Washington State University [WSU], 2006). Hunter-gatherers created basic frameworks for economies to exist and cultures to evolve. This in turn supported the growth and development of civilisations through exchanging objects of perceived higher value while also contributing to the spread of information around the world.

Within a modern context, communications technology has effected new business models and influence within market environments. McLuhan (1969), also made note of the business community and the modern metaphoric term of the 'hunter'.

> *All the business community, all the learned community is engaged in hunting today. We don't have goals anymore; we play the total field. The hunter plays the field. He doesn't have a goal anymore. These are the images of our time - the hunter. All the key figures of our time are hunters. Hunting is a pure thrill. Knowledge seeking is pure thrill.*
> *(McLuhan, M. 'Idea', CBC Radio, 1969)*

The concept of the modern 'hunter-gather' metaphor provides additional context as a 'persona' (Olsen, G., September 14, 2004) to support strategic decisions. However, Olsen (2004) points out that persona information is often regarded as being too 'vague' and lacking in detail. Additional demographic information supports observations into market information audiences (Pew Research Center for the People & the Press [PRCPP], 2000). Viewers now gather different information sources to support their decision making process.

While survey information shows a wide demographic profile, identifying suitable relationships that support investors interaction with information and the emotional aspects of the viewer experience provide better insight.

From observing the discussions within the Internet TV channel *Traders Nation*, the similarity of 'hunting' to the market, led to 'dating' metaphors. Further, investigation into "courtship's" (e.g., *The Mystery Method*), led to similarities with market information relationships.

A key academic work entitled *Market Metaphors for Meeting Mates* (Ahuvia & Adelman, 1993) pointed out this relationship. This paper provides evidence of this relationship by professors Ahuvia (Marketing) and Adelman (Communication Studies), with theories of 'mate selection' (p. 2), 'exchange' (p. 2) and the "courtship process with the stock market" (p. 8). These metaphors support better understanding of market information relationships. This is significant, as it also supports the concept of selection 'switches' used within more complex evaluation strategies, and therefore assist with evaluation of information. Within any complex decision including that of 'mate selection' not just one, but many variables are taken into account.

Observations made during this research showed that within market presentation discussions, stocks and partners are referred to in similar ways. Ahuvia and Adelman (1993), compared the 'dating' metaphor which also uses a "strategic decision-making process by which singles evaluate potential partners" (p. 10). Ahuvia and Adelman (1993) point out a similarity in dating and the market model for information exchange, and therefore believe that "the goal in dating is the efficient exchange and processing of personal data to quickly and efficiently establish the future prospects for the relationship" (p. 14). In addition, information disclosure may hinder "formation of a relationship in other ways" (Ahuvia, A. & Adelman, M., p. 15, 1993).

Disclosure of information may have either a positive or negative effect on the relationship that the viewer has with the information. Within a market reporting context, information influences investors decisions to buy or sell, depending on the 'message' within the report, and therefore influence the emotional response resulting from the connection between the information and viewer (e.g,, fear and greed). For those who are experienced and successful with Stock Market investments, how they respond to their emotional response is important, which provides them with better control over their trading decisions. This is because successful traders often focus upon selected information sources and insightful knowledge to support their decisions or trading strategy. Appropriate information summaries become an important factor associated with 'capital preservation' within market investing.

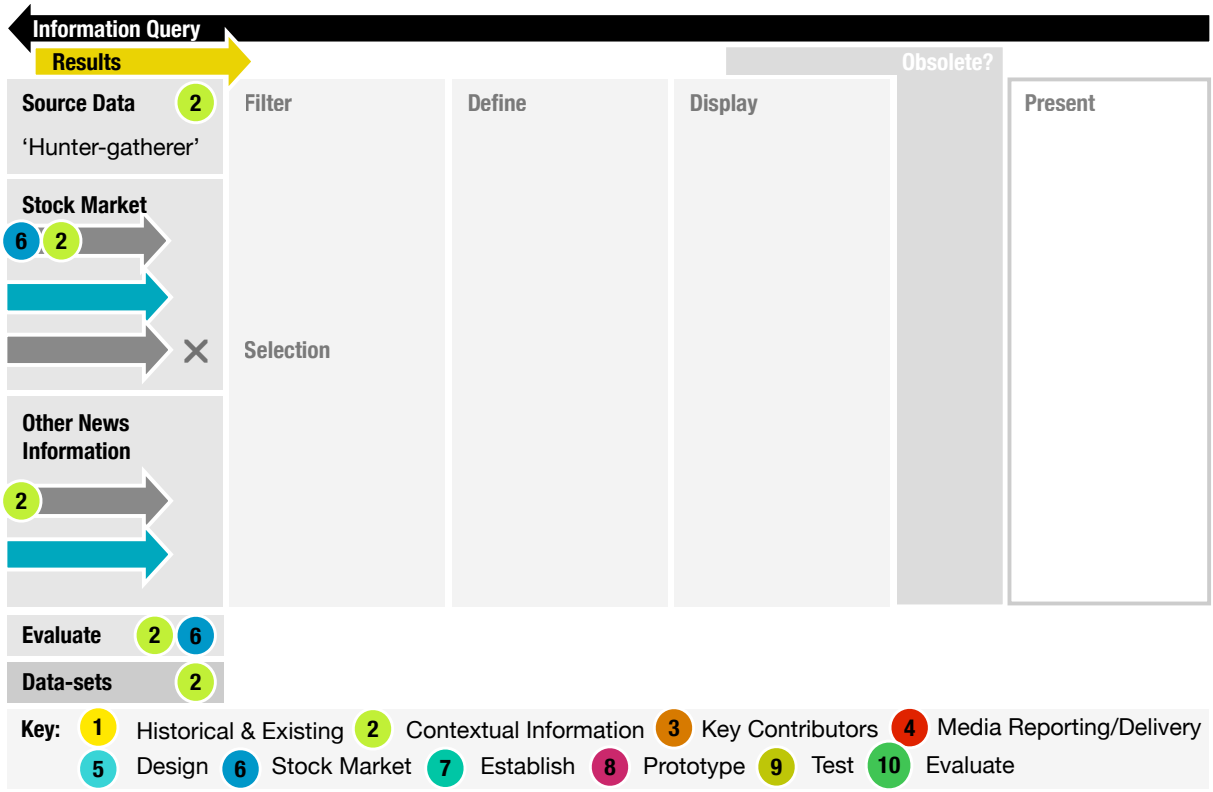

Fig. 2. Agent query is made to various data sources[4].

Trading

Market trading is a reflection of many people interacting on a large scale, that generate large amounts of recorded quantitative data through stock exchanges. The difference in decision making behaviour of those who are trading creates the market which can also be observed within trading data. McLuhan also points out that that everyone experiences more than they understand, however it is "experience, rather than understanding, that influences behavior."[5].

Early origins of the Stock Market derived from other forms of trade associations. The modern Stock Market with daily trading now largely driven by computer based trading that is a departure from 'open outcry'[6]. Before the introduction of online brokerages, trading decisions were made through discussions with brokers - for those investors who were not part of larger financial institutions with access to trading systems. Market 'orders' are made up of 'bids' to buy at a specific price, and 'ask' or

4 Refer to Fig. 1, for details.

5 See *Understanding Media: The Extensions of Man*, McLuhan, M., (1964) http://cultofjim.com/scripture/understanding_media/

6 Used within physical locations with traders interacting with one another - for example by the New York Stock Exchange.

'offers' the stock at a specific price to sell. These orders are comprised of the stock symbol, volume, price limitation, and how long the request is valid for.

Within modern popular culture, trading has also become a significant component of computer gaming models and online virtual environments (e.g., *Second Life*). Trading within games enhance play, through the exchange of 'virtual items' with other players. New interfaces will support the growth in trading between future 'virtual economies'.

Activity

From an activity once carried out though physical 'open outcry' trade interactions, still used by the New York Stock Exchange (NYSE), internet trading led to the "reduction to nonentity" to use McLuhan's term. However, everyone who participates through trading activity influences the direction of the market through recorded trade transactions. As McLuhan (1997) points out, "the more the data banks record about each one of us, the less we exist."

Totaled trading activity contributes to market change as a whole and recorded as an 'index'. The 'index' is a pointer (part of semiotics theory) to companies belonging to the 'composite'. This provides a general indicator of market direction. The connection between the 'index', and companies that belong to it, should be logical and organic. However, this is not often the case with displays that show arrows used to signify market direction and no other visual support.

During the upwards 'bull' market of the late 1990's, the interest in trading increased, supported by large growth in online trading (Bender, L., 2005). The activity of the financial markets with increased market transparency, speed of communications, changes in fund management and retirement savings, are set to change over the next decade. This will mean that the individual investor will need to become more aware of what's happening within the financial markets to achieve 'better than average' returns.

Both exchanges and brokers are regarded as stakeholders with an active interest in increased market activity, to increase revenues with the trading or other services (Bender, L., 2005).

News, Information, Reporting and Delivery

Broadcast news and reporting rely on timeliness for delivery. The time constraints of broadcast news reports, restrict value to the information contained within the newscast. Research into broadcast news, shows differences within news segments and stories. Within *New Zealand Television: A Reader* (Farnsworth & Hutchison, 2002), evaluation shows item length, frequency, and priorities (p. 130-132) for TVNZ News stories in 1993.

According to Farnsworth and Hutchison (1993) business and economic items were longer items resulting from "complexities" (p. 131), "left unexplored" which was largely because of the fact it was also "mysterious" to most journalists. Nightly market reports displaying indices show a "non-explanatory stance" (p. 131) compared to other stories which use "composite" reporting (i.e., multi-layered accounts used to show various effects). Economic stories by comparison use "wallpaper images" (p. 130) and hence, took longer to tell.

Competition between channels means that "technological capacities are shown to the greatest effect." (Farnsworth & Hutchison, 2002, p. 132) New 'technological capacities' have contributed to towards innovative reporting methods that have become more apparent within weather segments.

Newer non linear 'on demand' internet structures are being adopted by existing TV broadcasters. News reporting and delivery has undergone significant change with the introduction of the internet and aggregated sources of information. The role of the database for publishing, has also been a large factor to the change. Existing broadcasters have had to quickly adapt because of the growth in new internet models. This has led to broadcasters offering 'on demand' reports through video portal style websites. Viewers can provide comments, and other feedback on news reports, therefore improving journalistic interfaces.

Internet based models (e.g., Google News or Yahoo News), allow us to configure our news preferences and collect relevant news information specific to our tastes keeping us up to date. However, within some cases news might only hold value for a short amount of time, after which news becomes history.

The role of intelligence within reporting contributes to compositing news stories from multiple ideas. With internet based models, one source may become spread easily and 'mashed' up. News created from various electronic sources where there is a lack of truth, originality or citing of sources, is also of concern, providing current debate between new and traditional news publishing organisations.

The most up to date information can assist with decisions, therefore, the timeliness and relevance of this information are important. Consequently, outdated, incorrect,

or biased reporting effect our decisions. Hence market 'noise' must be filtered from the 'signal' announcements, with a 'figure/ground'[7] style relationship.

News reporting that cuts through the 'noise', offers potential for delivering relevant information to suit the viewing audience. The role of news reporting is to extract suitable information and provide insight.

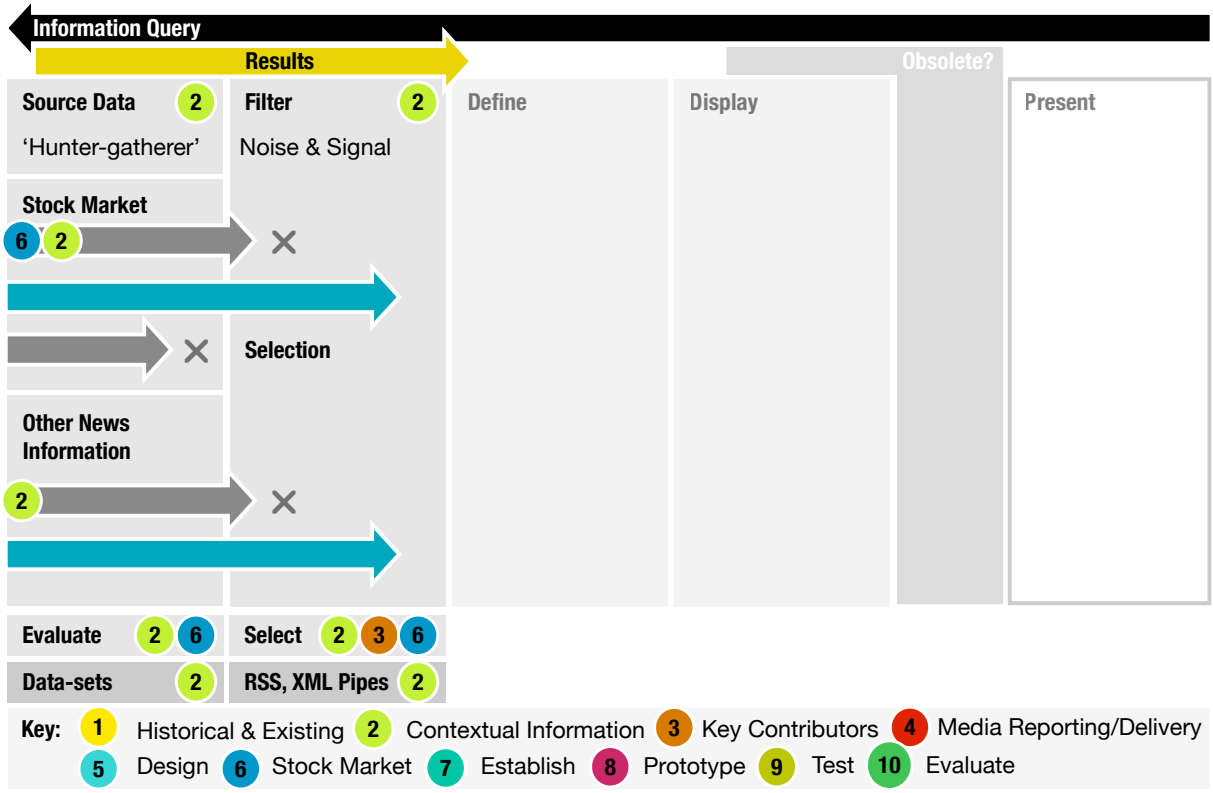

Fig. 4. Filtering and selection of data.

Up-to-date reporting methods support market 'transparency'[8]. This is to create a 'level playing field' for investors who need to be kept informed - more critical for shorter term trading decisions where timeliness is important. However, all reports associated by companies, build up a larger picture of events over time.

Information reported to the exchanges by companies, then released by the market announcement platform. Semantic guidelines for formatting reports, governed by market regulations, provide qualitative control. Observations into market reactions to reports show ephemeral movements after announcements being made. For example, positive news released 'end of day', often results in upwards price movements the following day, resulting from trading interest, and speculation.

7 McLuhan's 'figure/ground' relationship http://www.collectionscanada.gc.ca/innis-mcluhan/002033-2020-e.html

8 See http://mayin.nfshost.com/ajayshah/MEDIA/1999/transparency-matters.html

Market Education

Stock Market education requires various information sources to be understood. However, for people to understand it better, this often requires self-taught education. Learning from others mistakes and experience, provides insight, and knowledge, reducing costly mistakes for beginners. Knowing what information is relevant, becomes part of the education as a 'filter' (e.g., a trading strategy), used to evaluate information. As people become more successful, or gain additional market knowledge, improvements are reflected in decision making. There is a common belief that market investing is gambling. However, it requires a total disregard of information for this argument to be true. Those who gain experience know how to filter information and use 'probability' to their favour.

> *With every experience, we acquire knowledge; it is the understanding gained through experience - good or bad. Knowledge is communicated by building compelling interactions with others or with tools so that the patterns and meanings in their information can be learned by others. (Shedroff, N., 1994, p. 4)*

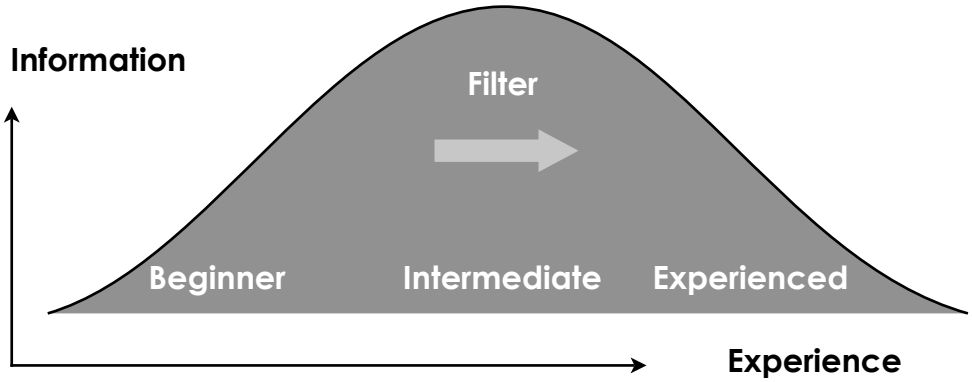

Fig. 3. The beginner is quickly overwhelmed by inefficient filtering of information. As experience is gained filtering becomes more effective.

Market education uses various information 'tools' and resources. The selections of stocks and trial portfolios provide 'paper trading' scenarios, without any financial risk to beginners learning. In addition, it is through the introduction of the 'tool' to support learning as metaphor - as discussed by Saffer (2005), which also supports teaching (p. 4), as well as influence or change behaviour (p. 21).

Selecting relevant information would require the use of a filtering 'agent'. A transparent evaluation process would also create an 'educational effect'.

Educational Programming within Broadcasting

Television provides quick and efficient forms of 'knowledge transfer' through news reports and educational programmes. McLuhan points out that the "Teaching Machine" (McLuhan, M., 1997) has educational effects because of technology, and the role it has in making information accessible. In 1965 McLuhan offers a more specific example of the educational use of TV. McLuhan (*'Take Thirty',* CBC Television, 1965*)* suggested that the use of the TV within the classroom would transform the teaching process. The effect of this would be like "bringing the Trojan horse inside the walls of Troy." This would lead to the creation of a "new educational form."

In the model presented (Fig. 2) the 'Trojan' would become the selection agent (with suitable examples), and therefore effect decision making as the strategic objective.

For a more recent example, as discussed by Prichard (2000), during the past Americas' Cup campaigns, a large amount of sailing-illiterate New Zealand public, were educated by broadcast simulations.

> *Simulation is part of modernity's broader processes of objectification and rationalisation. These processes on the one hand allow us to more intensively know, and thus control, the world.*
> *(Prichard, C., 2000)*

Simulations using multiple camera views became an important part of each race broadcast. These provide insight into the action happening 'live' on the water, and combined with commentary for the 'lay person' to improve 'mental models' by viewers. Hence, these models acted as broadcast forms of 'learning objects' (i.e., audio visual media elements for communication of educational material).

Similarly, good visualisation and supporting graphics within weather presentations have improved viewers awareness of patterns and assisted with their own 'mental models' of weather change to create additional viewing interest. The use of dynamic live information screens also assists an event commentary.

However, unlike visuals used within sports and weather presentations, there is little exploration within financial presentations (i.e., primarily those for the Stock Market). As Roberts (2004) suggests that "finance, however, has done little with the discipline of visualisation to date" and that there are "immediate rewards to those who are able to derive meaning" (p. 7). Most of the research found to date is not derived from the discipline of design, and therefore provides opportunity to for improvements within market communication and reporting.

1.1.2 Online Revolution

The Internet has led to a significant change in the way people access news sources. In a US broadcast news audience survey, shows that there has been significant change in the way people access news media. The survey entitled, *Internet Sapping Broadcast News Audience* (Pew Research Center for the People & the Press [PRCPP], 2000), shows the shift in viewers towards the internet. This study explores a variety of topics, including significant focus on financial news and provides information on viewing demographics. In addition, the research sampled 3,142 adult participants over the age of 18, conducted between April 20, and May 13, 2000 (PRCPP, 2000, p. 18). 'Fragmented' audiences (PRCPP, 2000, p. 4) are a result of media changes, due to the fact that the internet is now a primary source for news information (PRCPP, 2000, p. 6). For those viewers who are also 'active traders' (i.e., traded stocks within the past six months), it shows that the internet "supplanted traditional media" (PRCPP, 2000, p. 2), which has cut into consumption of other media sources (PRCPP, 2000, p. 10). The internet now supports quick updates and more in-depth stories (PRCPP, 2000, p. 1). This information supports the focal persona: the viewer and trader who have an active interest. Information empowers 'active traders' and provides a sense of security, and confidence.

Furthermore, business and finance are popular amongst other internet news categories (PRCPP, 2000, p. 8), because of fact that online news viewers are 'heavily-engaged' with the Stock Market (PRCPP, 2000, p. 8). Active traders who have a 'strong interest' in the news, frequently access market information (PRCPP, 2000, p. 9). Viewers also had a wide range of news interests on many different subjects (PRCPP, 2000, p. 10). While most viewers have an interest in customising financial information, particularly customised portfolio news, "little have interest in tailing all news in that manner" (PRCPP, 2000, p. 11).

Similarly, the news release entitled *Study offers early look at how the Internet is changing daily life* (Stanford Institute for the Quantitative Study of Society [SIQSS], February 16, 2000) with the impact of the internet on viewing behaviour, consequently taking time away from other media use. In addition, this internet study also points to viewer demographics and interests to include stock quotes, trading and other business information, showed more male interest[9].

However, no recent studies with the same depth or relevance, shown within the previous examples were found.

9 Refer to (pp. 28) http://news-service.stanford.edu/pr/00/000216internet.html

Financial Services

During the late 1990's 'full service' brokerages were greatly effected by the emergence of the 'do it yourself' cheaper, faster, and more accessible form of online trading before the 'dot com' NASDAQ crash in March 2000[10]. However, unlike the market of the late 1990's, today's trader is more 'savvy', with an awareness of impacts that fundamental information has in supporting decisions. The information available online is often difficult to make any sense of by investors but an important part of investment due-diligence. The time required to have a suitable understanding of a particular company often means that some opportunities cannot be taken advantage of. It has been shown that out of those who do have portfolios, only a few are making use of online resources to assist with their decision making.

Furthermore, full service brokerage, or "matchmaking service" (Ahuvia & Adelman, 1993, p. 8), provides 'selected' stock service for investors to choose from. However, this often leaves the investor with doubts over what information to believe. The investment decision is largely due to the investor following the recommendation of the broker. This defines the secondary persona who is less active in seeking market information, but wishes to know that they are 'on the right side of the market' longer term.

Financial Data-sets

Every data transaction and change is reordered in real-time during trading and made available through stock exchanges and data providers. Financial data-sets support improved information displays, some of which offer proprietary information views (e.g., Ameritrade's *Quotescope*™, Smartmoney *Marketmap*™) created through aggregated data sources.

Financial websites (e.g., *Yahoo Finance*), offer freely available delayed and historical data-sets. These data-sets provide current and historical information that goes back to the time of the initial listing of the company and contains information on the stock price, results, announcements and events.

There are also specific formats developed to support financial data-set information (XBRL; eXtensibile Business Reporting Language, MDDL; Market Data Definitional Language), which both contain XML (eXtensible Markup Language) mechanics. XML is a W3C initiative that stores information with meaningful structures and semantics accessible to both humans and computers, while also supporting greater syndication of information.

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10 See http://www.investopedia.com/features/crashes/crashes8.asp

Data-sets within this research were analysed for potential use, and understanding of the data variables extracted from XML based structures once filtered. This provided the basis for understanding. The variables within the XML structures are translated through the design process and turned into 'graphical listeners' to enhance communication.

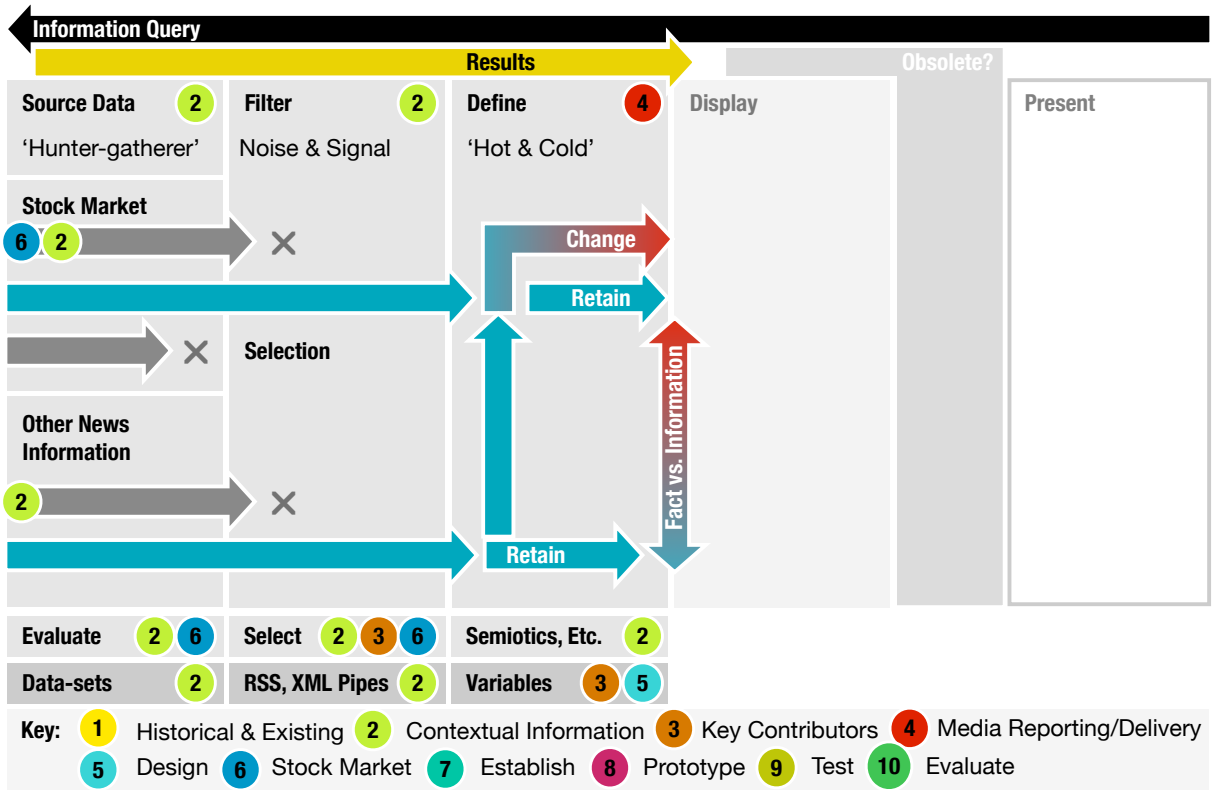

Fig. 5. Redefined data - enhanced for communication.

Different media formats assist with delivery of information. McLuhan (1997) explains the different experiences that each 'medium', by 'polarity' theory, and that there is a 'hot and cold' experiential nature of different media. 'Hot' media, or high definition media, and therefore provided a state of "being filled well with data" (McLuhan, M., 1997, p. 160). 'Cool' media however, which is more symbolic, allows for audience participation and interactive forms of media, but this requires more completion by the audience so that they are 'filled in'.

1.1.3 Raw Information

Creating value from data must first start with good raw sources. Financial markets generate a large amount of information derived from various data sources. Live market information supports quick decisions, while historical information is also rele-

vant and built up over many years to record change in indices and listed companies. Each market exchange generates large amounts of data constantly, creating management issues that have lead to research into new and better ways of managing such sources, and how that raw data can turn into 'enhanced' information.

Constant generation of raw data at exponential rates through recordable transactions, leads to the issues effecting the use of visual arguments - explored by researchers. For example, Hans Rosling of *Gapminder* (2006) creates new and interesting visual arguments that improve the understanding of world health trends. Rosling uses connections to large amounts of raw data to assist with construction of his visual arguments. However, raw data is often located in multiple databases or locations making aggregates via multiple queries (e.g., SQL) difficult. Multiple sources to be queried simultaneously ('data mining') with the aggregated results customised to particular requirements or information relationships. Structured formats (e.g., XML), then provide the accessible information to developers.

As Koomey (2001) discusses, it is the 'data point' variables contained within the information sources that are important. Variables can then be 'mapped' to visual outputs or 'graphical listeners'. These would display either textural information or supply information that can effect visual changes on screen. For example, a company stock price variable is meaningless in data form. When compared to the same variable in the previous record of the series recorded over time, the data becomes fact (e.g., stock price is up). The stock symbol (letter codes to signify company) serves as a quick reference pointer to the company information, and current record in the time series.

Market broadcast news, presented stereotypically as 'fact' appears to be the inherent 'problem', that holds 'little value' to viewers. This is because of the contextual limitations. An initial investigation into the value of broadcast news, showed that most users turned to the internet for more in-depth information (as discussed in PRCPP, 2000). If market graphics are presented as 'fact', then this is consequently due to over 'simplification' within the design? The use of the voiceover - transformer of fact into information, is not seen as significant enough to provide value to market reports. Facts learned about something (or someone), are part of the larger information context, conveyed or represented through interpretation. With this difference identified, the design response provides exploration into the use of other elements to provide 'context', and therefore increase the information 'value'.

Screen captures of stereotypical examples can only be viewed as 'fact'. No other 'valuable' information can be obtained, because it no longer retains information embedded within the voiceover. This has led to the reliance upon the presenter

in supporting onscreen displays to support this relationship. Very few examples showed the presenter alongside market information (e.g., Fig. 21., *Russia Today*).

At this point, data becomes transformed[11] into usable information that can then be enhanced through the design process and given additional value by making additional connections (e.g., stock price is up on positive news). However, within existing market reports, the transition of fact into information, is largely carried out through the voice over comments provided by the presenter.

Hallock (2005) states that the information designer organises and "makes sense" of existing data by transforming it into usable information (p. 8). Value through design is added by enhancing viewers understanding and clarity of a particular subject. This may require the designer to 'research and discover' the data. In addition, suggestions by Hallock (2005) and Koomey (2001), have been applied to this research by examining the significance of information variables. Principles can be established further through multiple connections of information and knowledge. Therefore, Information Design is largely dependent on the quality of the connections made by designers (Saffer, D., November 5, 2003).

As Rosling (*Gapminder* [12], 2006) has shown, when the data series has been mapped with time, understanding and clarity of information is improved through visual change (e.g., movement, size, object temporal relationships), and therefore raw information becomes a key component to the process. Quantitative data presentations by Rosling (*Gapminder*, 2006), provide new insight or knowledge of problems. For this reason, integrated data-sets and the derived information, become an important part in driving design solutions utilising streaming graphics.

Filtering data while providing more accessible information through series, assists with understanding over time, an important part of providing clarity to information trends. This makes the information more accessible; not hidden within the depths of information sources, as the case maybe with internet data resources.

1.1.4 Information Collection, Organisation, Display

The information collection, organisation, and display process, requires many components. It is also important for the developer to know what information is available for use, the integrity of that information and where it comes from. For the designer it is important to know what information variables could be turned into 'meaningful information'.

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11 For differences between data and information see http://jmcsweeney.co.uk/computing/m150/differences.php

12 Also see http://tools.google.com/gapminder/

Firstly, the collection of information would use 'aggregation' techniques to work with multiple sources. Various formats of storing information (e.g., XML), support structured, easily accessible information. Customised financial XML formats contain more information variables than the RSS (Really Simple Syndication) format suited to news feed situations.

Secondly, organisation of information makes use of database solutions. These provide XML feeds for developers to work with information variables. The published XML feed is 'organised' information, using structures, applied to different media solutions to support dynamic or 'live' information displays.

Database as a Genre of New Media, (Manovich, L., 2000), discusses the role of the database as a "new symbolic form of a computer age" (pp. 3) to drive information displays as more of the information we use on a daily basis is stored within data structures. Structures may also become rearranged within new media through the use of algorithms (pp. 7).

Within the thesis entitled *Computational Information Design*, (Fry, B., 2004), information visualisation, data-mining, combines with graphic design. It is through the combination of fields into a "single process" (p. 1) that defined Computational Information Design. However, the aim is similar to this research: that is making data more "accessible to a wider audience" (p. 1) suited to both 'beginners' or 'advanced' users.

Thirdly, display technologies are linked closely with design solutions. *Quartz* display technology, part of the Apple Inc. Mac OSX Operating System was explored within this research. Dynamic realtime experiments showed potential for future development suited to both prototyping, or use within custom applications.

2. Delivery

New media formats are closely bound by the influential nature of different media delivery methods and limitations or possibilities for both creators and viewers. Traditional broadcasters are faced with adapting to newer scenarios, leading to increased channel separation. The growth in channels supporting particular viewing interests has increased to provide niche content. Within the article entitled, *An analysis of graphic design on UK terrestrial television, and the effects of multi-channel growth* (Lloyd, P., 2004) provides insight into branding and identity design considerations, along with graphic design within UK television (p. 3). As Lloyd (2004) pointed out, the effect of 'multi channel growth' had an influence on broadcasters during the 1990's. Consequently, many broadcasters had to reinvent themselves (Lloyd, P., 2004, p. 3). Multi channel growth from the development of cable and digital television, led to the increase in channels that could be broadcast (Lloyd, P., 2004, p. 4). Lloyd (2004) also believes that the introduction of multi-channel television during the early 1990's changed the face of channels from that of "individualism and variation across channels and networks, to conformity and consistency through the use of branding" (p. 33).

Due to the internet growth, niche audiences will continue to be supported as part of the 'Long Tail'[13] economy that has developed to support niche products and audiences. As new media evolves, convergence between internet and TV based technologies becomes increasingly relevant. As Mcluhan (1997) observes, because of newer emerging media and information formats, older formats would then become 'obsolete' (p. 167). However, as McLuhan points out, the role in which the 'obsolete' takes, is then changed from the when new media is introduced. McLuhan illustrates this by discussing the change from manuscripts to mass produced information forms (e.g., the printed word and cinema), and how new media forms effect older ones (McLuhan, M, '*Understanding Media*', 1964). For instance, within the context of terrestrial market information broadcasts, this format is made 'obsolete' to use McLuhan's term, as new forms of more timely market information provided through financial websites supporting frequent updates and more in-depth information. On the other hand, the television still provides a more efficient and experiential way of delivering news footage, due to the fact that terrestrial broadcasting provides easy access to large size video footage without bandwidth issues. Viewing can also support much larger screens in higher definition (e.g., HDTV; high-definition television), and now becoming increasingly connected to home media networks.

13 See http://www.oreillynet.com/onlamp/blog/2005/05/the_long_tail.html

However, various media organisations and services (e.g., video on demand services and TV network station websites) support the increased viewing of video footage through faster internet connections. TV media repurposed for the internet, is growing at an 'exponential rate', making broadcasters rethink about the way they deliver and archive content. TV content is being redelivered in the most common media formats (e.g., *iPod* supported formats, *YouTube*) for download.

Technological change has also led to the growth in displaying video footage and information supported by IP (Internet Protocol) delivery methods (e.g., IPTV, Internet TV, Narrowcasting, Personalcasting).

IPTV is largely "carrier-led and controlled platform" supported by cable and telecom companies with fast internet connections through "a massive connectivity infrastructure." For this reason, IPTV is "fundamentally geographically-bound", and deployed largely with using "proprietary" systems as discussed within the article entitled *IPTV vs. Internet Television: Key Differences* (Good, R. , June 4, 2005). As Good (2005) points out, IP (Internet Protocol) media is delivered using data connections and set top boxes - not necessarily accessible via web pages. IPTV is suited to "established" media production organisations and provides content similar to digital cable and satellite providers offering video on demand. Internet TV is a more 'open solution', to content producers that is 'device independent' (i.e., supported by wireless or mobile internet connections). Internet TV is "deeply integrated into the existing Internet user experience," without requiring major infrastructure "overhaul". Furthermore, Internet TV offers a "global reach business model" (Good, R., June 4, 2005). Significant efforts in open source publishing solutions made by organisations (e.g., *Participatory Culture*) also provide alternative publishing platforms.

Both IPTV and Internet TV are a result of 'Long Tail' economic trends, where there is a greater focus on serving niche audiences. The result of which, supports "an explosion of niche content" and customised services. The current trend indicates that both IPTV and Internet TV will big part of the way we consume media in the future.

2.0.1 Broadband and Narrowcasting

Other media solutions use internet based protocols offer an alternative to more traditional terrestrial broadcast methods.

Broadband connections are the most 'general' connections for delivering internet media. The most common format, being video on demand, or dynamic web page information. In addition, the development of online 'in-stream' advertising has also supported the growth in delivering video content using broadband connections. The combination of in-stream ads to support 'free content' and other revenue

techniques are a successful business model used by Internet TV channels (e.g., *Traders Nation*). Other market related Internet TV spots - for example *WallStrip*[14], uses the end-of-stream format. The ability to quickly adapt to the ever changing environment is also an important factor.

Narrowcasting however, has a more specific use, suited to commerce display solutions, public information screens, and advertising. Video clips, and information, are sent out from a 'master' server to 'client' displays (i.e, from one controlling storage media device and scheduler to many media displays). The more media focus that is given to the 'client' the more 'personal' the information display can become (e.g., by using RFID; radio-frequency identification, or other personal information technologies).

2.0.2 Personalcasting

Personalcasting relies on query or preference driven media delivered through syndication methods. This makes use of watch-list style settings so that the viewer stays informed of specific events by selecting and organising relevant content.

Within, *PERSONALCASTING: Tailored Broadcast News* (Maybury, M., 2001), Mabury defines Personalcasting by comparison to existing 'one to many' broadcasting and states that Personalcasting differs from traditional broadcasting because it supports 'one to one' media delivery. For this reason, Personalcasting can create "stories based upon specific, individual user interests from a variety of sources and presented in a form tailored to user preferences" (Maybury, M. et al., 2004, p. 32), therefore supporting the personalised definition. In addition, creation of personalised channels is based upon query results (Maybury, M., 2001, p. 1) that are tailored to individual user interest. The design solution explored within this research looks at the inclusion of personalcast style information components combined with other internet supported delivery modes.

Personalised Information

Websites offering personalised trading information allow for users to receive only relevant information through the setting of preferences. Personalised trading information is largely carried out through automation processes linked to the individual preferences. This supports 'filtering' of non relevant information and allows both short term traders and longer term investors to focus upon relevant change depending on

14 See http://www.wallstrip.com

their needs. However, some diversity provides additional opportunity or interest. This also relates to the use of intelligent 'agents' to selectively filter information based upon personalisation.

For 'enhanced' TV services, *PERSONALCASTING: Tailored Broadcast News,* Maybury (2001), discusses personalisation of information that can be tailored to market news. This provides an example of personalised information to support trading.

2.0.3 Streaming and Live Feeds

Automated reporting is important because it deals with the issues surrounding 'live' information formats that occur within news and used for daily repetitive reporting. Good examples of automated reporting can generate reports that look as if written by a normal person. Reports are created by pulling information from aggregated sources and then following language principles and story structures. In addition, it is through automation, that support can enhance 'personalisation' by tailoring of information within news services. As McLuhan pointed out, "the age of automation is going to be the age of "do it yourself " (Marshall McLuhan, 1957) as technology changes. Intelligent agents will continue to evolve to support more complex forms of personalised support.

Furthermore, automated reporting provides syndicated content requiring little or no human interaction. For example*, STOCKTEXT – Automatic generation of stockmarket reports* (Sigurd, B., 1995) looks a these issues. Automated reporting within commercial systems (e.g., *Bloomberg*) use similar methods (*'Bloomberg by Bloomberg'*, Bloomberg, M. 1997). Sigurd (1995) points out that computer based reporting involves; "linguistics: semantics, pragmatics, lexicon, morphology, syntax, text linguistics and – if the output is to be speech – also phonology and speech technology" (p. 1).

In addition, the development of market reporting methods illustrates that it is possible to automate repetitive stories that often follow ready-made phrases. To achieve this, sentences are constructed between the values of financial items, events, or other cause and effect relationships (Sigurd, B., 1995, p. 3).

As a result of analysing existing reporting structures, Sigurd (1995) explores text generation through computer subroutines (i.e., to make calculations, comparisons), to format the information in a specific way while applying grammatical formulas (i.e., the order in which to say it, how it is being said). The output from such systems could then be applied for uses within other applications (i.e., teleprompt scripts, news paper or website news articles and text to speech applications). To readers, this appears with grammatical structures like any other report (Sigurd, B., 1995, p. 3).

2.0.4 Structuring the Overviews

Today, more efficient methods for news composition are required to work with the fast changing media environment. New composition methods take into account specific content structures to support stories. Daily market reporting often follows similar structures used for story segments (e.g., weather reports). Many studies have explored automated composition production methods.

A Language to Support Automatic Composition of Newscasts (Ahanger & Little, 1998) investigates the process of automating news video production. The language supports the dynamic assembly of compositions and footage for information customisation applications (Ahanger & Little, 1998, p. 1). This work analyses the structure of a newscast by working with content metadata to support playout of media for news reports and involves selection, manipulation, and composition of information (Ahanger & Little, 1998, p. 2), through query driven search terms. It was found that the 'temporal constraints' (e.g., the duration of the media for playout), limited the capabilities for composition. As Ahanger and Little (1998), point out, the compositions take advantage of format driven footage depending on the target video piece (e.g., a news item composed of an introduction, field shots, and comments) (p. 3).

The issues and limitations from this type of news composition relate to the delivery of media (Ahanger & Little, 1998, p. 5). Manipulating the video to playout in a logical way is critical for such a system. According to Ahanger, and Little (1998), news items, broken down into their compositional objects, support relationships to other news items, segments, or newscasts (p. 12), and then further still into sub objects (e.g., headline, introduction, entity, location, and action).

Ahanger and Little argue that content cannot create a newscast alone, therefore, it must take into account the structural language of a newscast. Structures of stories evolve through changes in information or events within time series. Moreover, chronology of information becomes more important to the presentation order. Furthermore, Ahanger and Little (1998) suggest that clips would need to be "presented in a temporal order" (p. 12) for better understanding (p. 19). Structural constraints achieve a more coherent composition, while specific algorithmic rules also accommodate redundancies. The problem is that similar segment types (e.g., introductions), need to be filtered down to single occurrences (Ahanger & Little, 1998, p. 20). As a result, the study proposed a language solution to support automatic composition of news items and newscasts (Ahanger & Little, 1998, p. 7).

Showing the Trend

The concept of 'trends' applied to three areas of investigation within this research to include: market, news, and those which influence design. Trends containing historical information could also be seen through McLuhan's 'rear-view mirror' theory. This refers to living with an eye on the past, which also relates to the evaluation of Stock Market historical trends.

Market trends are important, because they compose variables mapped over time to create visual representations of information which are efficient in communicating direction. Early representations of market information (e.g., candlestick patterns), were developed by Munehisa Homma (1724-1803)[15], a Japanese rice trader. This led to greater understanding of buyers and sellers psychology or 'sentiment' through trading movements. The use of trend information - generated from datasets, known as Technical Analysis, supports strategies by traders, institutions, or investors to improve their overall result. Trends largely apply over multiple timeframes, short or long, due to the nature of the data plotted through price vs. time. Similar patterns can be observed within different time-scales comprised of progressively smaller scales.

Edward Tufte has also explored market trend information, such as the use of 'sparklines' within *Beautiful Evidence* (Tufte, E., 2006, p. 7-18), and therefore provides discussion on the presentation of quantitative market information.

For general trends within news media - the internet provides realtime monitoring on how people behave online which is reported in "privacy-conscious" aggregate form. For instance, *Akami* networks monitors information trends providing near real-time news meter[16] which tracks current trends on news items, ecommerce and other network information. Similarly, Google also offers compiled zeitgeist[17] information, along with trend searches[18]. In addition, the Internet TV channel *Google Current*[19] uses Google trends to assist with editorial decisions and content selection.

Understanding trends and applying them to design concepts are also shown through the design methods by Del Coates (2002). Coates (2002, p. 53 & p. 66) uses the zeitgeist to support design concepts and strategies.

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15 Also known as Sokyu Homma, Sokyu Honma and Sakata. Source states 18th century - refer to http://www.hotcandlestick.com/candlesticks.htm), however other sources state 17th century.

16 See http://www.akamai.com/netusageindex

17 See http://www.google.com/press/zeitgeist.html

18 See http://trends.google.com

19 See http://www.current.tv/google

2.1 Visualising Summaries of Information

Visual summaries from large information sources assist with decision making. For example, within the thesis entitled, *Information Visualization for Stock Market Ticks: Toward a New Trading Interface* (Roberts, P., 2004), Roberts explores visualisation of market data to improve understanding of market movement.

Roberts (2004) identifies changes in early mathematical history that led to the departure of 'graphical reasoning'. According to Roberts (2004) the change in mathematics meant that it had left some of its early graphical roots that pioneers; i.e., Archimedes and the ancient Greeks had shown, hence "graphical reasoning" had been left behind compared to "symbolic reasoning" (p. 7).

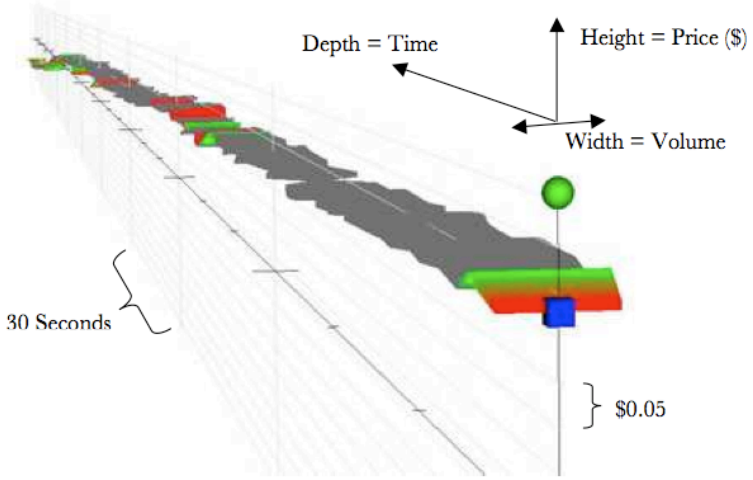

Fig. 6. 'Datamapping for Focus View[20]*', (Roberts, P., p42, 2004).*

Roberts (2004) attempts to find a "visual language for trading" (p. 79) within his work amongst other financial visualisations. However, Roberts (2004) also points out that due to the nature of equity trading, any visualisation is inherently bound by the dimensions that exist between time and price (p. 79). The use of visual communication and design has the ability to enhance the "understanding of relationships, causation, scale and quantity" (p. 10). This enhances peoples 'mental models' and improves understanding. Graphic solutions support the human ability to discover and understand patterns (Roberts, P., 2004, p. 10). Roberts (2004) also cites Tufte (1990), to support his design.

In another Stock Market information example entitled *Butterfly/Dragonfly - An Ambient Display of Stock Market Data* (Nesbitt & Shen, 2006), live data and display metaphors show within the use of data 'painting'. This derived from an earlier work

20 *Fig. 21, from Information Visualization for Stock Market Ticks: Toward a New Trading Interface (Roberts, P., 2004)*

entitled *Using MoneyColor to Represent Financial Data* (Shen, & Eades, 2005). This type of ambient display, designed for user's 'periphery' vision supporting foreground, and background modes of attention, may also have a "learning effect" (Nesbitt & Shen, 2006, p. 2).

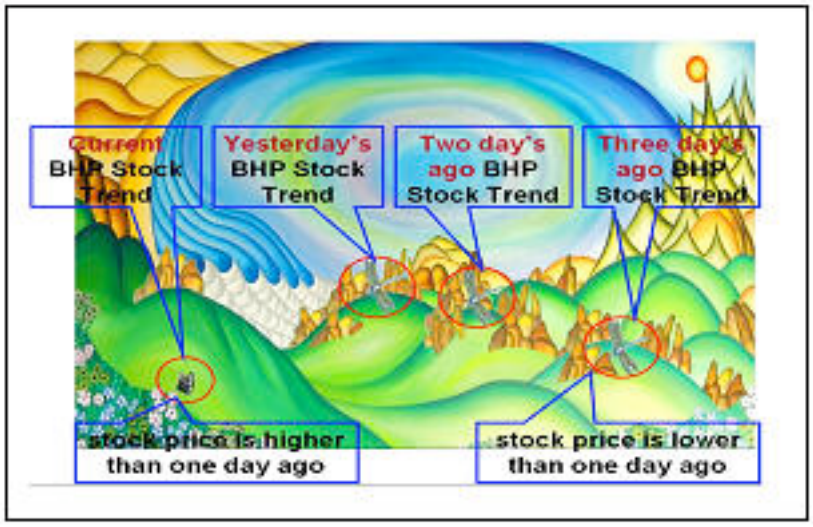

Fig. 7. Example of the interface 'painting' (Nesbitt & Shen, 2006)[21].

In addition, Nesbitt and Shen (2006) discuss issues surrounding comprehension and usefulness (p. 4), and provide quantitative results from their evaluation (p. 6-10). However, Nesbitt and Shen (2006) conclude that there is a "trade off between aesthetics and communicating information" (p. 10), and that the design may be influenced by the "passive or interactive" (p. 2; Grasso et al., 2003) nature of such displays.

The use of 'ambient' information provides relevance to the design outcome within this research. The background visual cues of 'macro' information change, provide related contextual 'forces'. However, additional information overviews would require the viewer to become more familiar with the presentation over time.

TextPool: Visualizing Live Text Streams (Albrecht-Buehler, Watson, & Shamma, 2004), creates visualisation of text streams using RSS (Really Simple Syndication) to support realtime newswire feeds. Although this is not market related, it is envisioned that similar methods would be used to connect information to the design outcome. Text streams assist with the understanding of trends as they emerge from many aggregated sources that are 'thematically related' (e.g., technology news, business, sports). Single newsworthy items, or 'content vectors' (e.g., 'energy prices'), that appear within current news items are displayed as visual 'nodes'. Future development

21 Fig. 4. Butterflies and dragonflies indicate a ranging market. http://www.scientificjournals.org/articles/1037.htm

suggestions from the study include the use of motion to improve meaning within the design (Albrecht-Buehler, Watson, & Shamma, 2004, p. 5).

3. Cognition

Understanding how quantitative information effects viewers is important to assist with the creation of solutions that work within any potential cognitive limitations. It is important that cognitive considerations, audience information processing and usability to assist the acquisition of knowledge are examined. Many of McLuhan's theories also have cognitive considerations (e.g., polarity, figure/ground, Tetrads) with different cognitive modalities discussed.

The memory is central to cognitive psychology (Saxton, M., 2002), yet 'working memory' only holds information for short amounts of time (pp. 8), however, through repetition, information becomes part of 'longer term memory' to support learning. There are also limitations to the amount of information 'chunks' that the 'working memory' can hold (e.g., digits, letters, words). Since our hunter-gatherer past, the use of storytelling has evolved as a method for improving memory recall[22]. Our abilities to effectively process and understand information, is often overlooked by designers.

Clearly larger information sources can impact upon information processing abilities. For example, finding relevant information within a company annual report becomes a difficult exercise for many, due to the feeling of being 'overwhelmed' by information. Yet, to someone experienced, they are able to focus on the small amounts of relevant information to support their decision making process.

Designing better summary views of information for 'working memory', can therefore support information in a more effective and efficient way - using higher level overviews that continually support contextual evaluation without 'overloading' the viewer. Cognitive Load Theory (CLT) takes into consideration sensory, working and long term memory - used within instructional and interface design (Pitts, Ginns, & Errey, April 26, 2006).

Cognitive understanding of learning languages also takes into consideration the short term memory and longer term memory and how the brain acquires information which is naturally developed for learning language. The Pimsleur Method [23] takes natural cognitive understanding into consideration through the use of graduated levels of exposure and "organic learning". Although this method has been widely applied to language learning, motivation by the learner is a contributing factor to the success of this method and therefore seen related to delivery of market related language.

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22 Refer to http://www.callofstory.org/en/storytelling/history.asp

23 The Pimsleur Method was developed in the 1960's and still in use today. Retrieved March 3rd, 2007 from http://www.pimsleur-language.com/method.htm

Cognitive considerations for information visualisation (Nakakoji, Takashima, & Yamamoto, July, 2001). shows that different aspects need to be considered (e.g., to compare, chunk, interpret, grasp wholes, focus, expect what is next, analyze), as each have very different cognitive effects (p. 4).

The existing research into cognitive abilities, and support for 'organic' style learning, are considered within the design solution. However, this would require further study and evaluation for any working model.

3.1 Audience Information Processing and Usability

Improving the acquisition of knowledge, requires suitable methods and principles for dealing with complex information. There have been various studies into audience information processing. For example, *Video Analysis and Summarization at Structural and Semantic Levels* (Sundaram, H. et al., 2003), investigates video content analysis, segmentation, event analysis, and summarisation.

When dealing with complex information within design suitable principles need to be applied. As Tufte (1990) points out, we often try to understand those things we see as being more complex (p. 51). Hence, designers often try and simplify things, which is often the case with broadcast graphics. While Shedroff (1994) argues that "clarity is not the same as simplicity" (p. 9), Tufte also argues this point:

> *Simpleness is another aesthetic strategy, not an information display strategy, not a guide to clarity.* (Tufte, E., 1990, p. 51)

Tufte (1990) suggests strategies that reveal detail and complexity, instead of fault the data for an excess of complication. Tufte (1990) claims that "confusion and clutter are failures of design, not attributes of information" (p. 53), while suggesting that design consistency can help place emphasis on changes in data (p. 67) to assist the viewer.

Viewing factors, device and interface limitations can effect the behaviour of users. Usability considerations for displaying information within different media devices and interfaces have led to considerable research within media systems (e.g., *Windows Media Center, MythTV, Joost, MediaCentral*). Furthermore, the usability report entitled *Results of a Usability Test of MythTV v. 0.19.* (iDTV Lab, June 2006) provides quantitative user-group results, from research into interface design and task usability.

Maybury (2001) also investigated usability to improve task performance (p. 2). In addition, other media usability studies include those investigating the convergence

of Web TV (Nielsen, 1997), Jacob Nielsen similarly discusses Web usability and accessibility issues in other publications.

Nielsen (1997), provides discussion on Web TV and usability within TV Meets the Web, and makes suggestions for improving new interfaces and the display of screen based information. However, as Nielsen (1997) points out, connecting to internet based media through the television can lead to control issues - impacting upon the viewing experience (p. 1). Nielsen further suggests that similar media can have "different properties and things that they are good at" (p. 1).

The studies outlined above examine viewer comprehension and retention of information, with suggestions applied to the final design solution.

4. Design

It is evident from existing research that there is a lack of critical design responses to support better understanding of financial information. As Roberts (2004) points out, better contribution through design is needed. However, to do this effectively - the design needed to use objects to display changing data making it easier for the viewer to derive meaningful information.

From the points made by Tufte (1990) and Shedroff (1994), clearly elements within the design need to be evaluated carefully as part of redundancy within design strategies. Information that supports the 'message' needs to be considered. Over simplifying elements may lead to loss of valuable information that viewers may need, consequently reducing the effectiveness or value of the 'message'. Techniques discussed by Tufte (1990) on a more technical level to support accurate communication. In addition, semantic structures that include language and symbols used to convey the 'message' can also benefit from design. However, the design of symbols to support communication also pose challenges for designers (Emerson, J., 2005, p. 16).

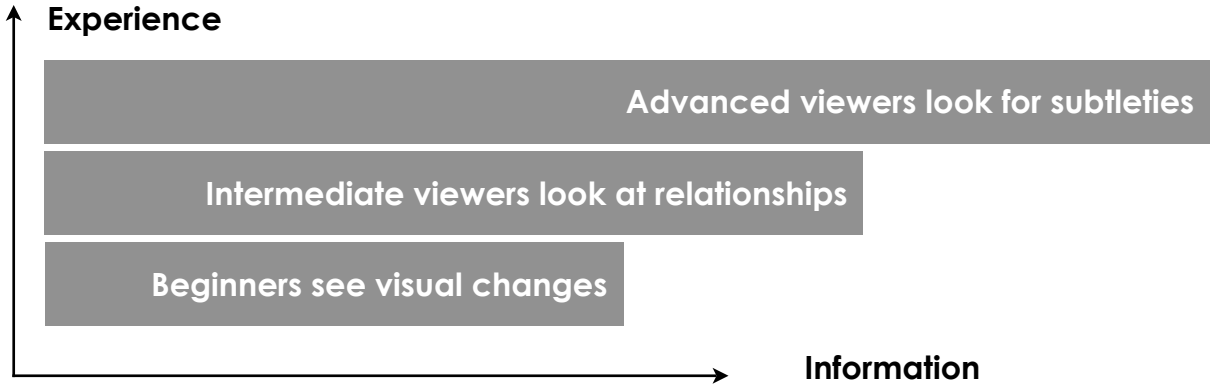


Fig. 8. Shows need for improved summary information.

Because of the abstract nature of market information - the development of signs or symbols becomes difficult. However, within this research, symbols direct attention to events etc. However, this must depend upon the viewers understanding, established over time. It is for this reason, that information variables turned into signs, should be 'logical' in nature, easily used by the presenter and learnt by viewers. These support the presentation to 'carry' the related market information variables. This strategy reduced the use of textural elements within the display for information elements, not used to display 'precise' variables.

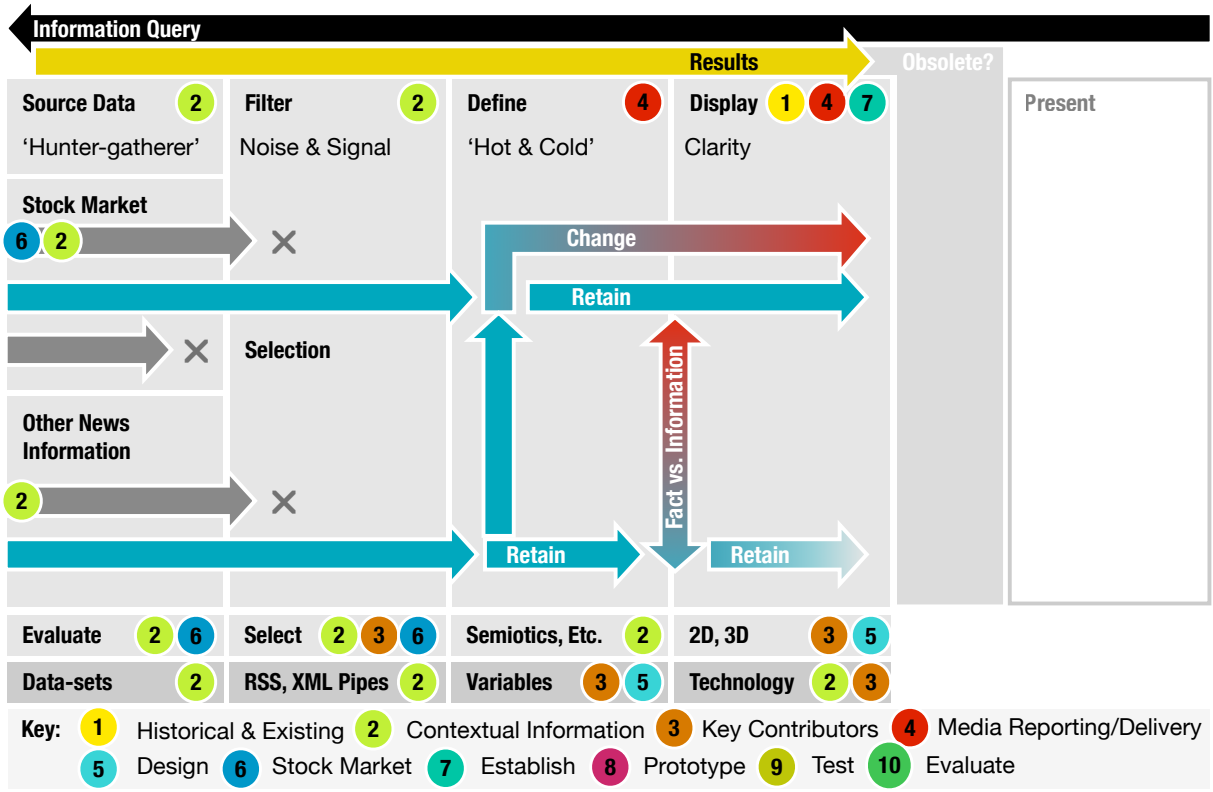


Fig. 9. Improving display of information through design.

The fusion between media has led to new convergence scenarios between 'hot' and 'cold' media. The Internet has changed media consumption, and delivery, leading to more diversity within media types and display situations.

As discussed within the article entitled *Why design matters* (Oram, R., 2005), Oram points out that "great design is deceptive. It looks simple and obvious" (pp. 1). However, Oram (2005) also points out that design is not just "skin deep," but creates additional value, which may "distinguish and differentiate itself" (pp. 3). It is also important that design that can integrate into everyday use creating a need for "good and accessible" (Oram, R., 2005, pp. 10) design.

Design plays an important role in improving the delivery of information services and systems that support better accessibility to summary level information. Clearly, a continued design response is needed to 'synchronise' this relationship. In addition, information needed by viewers to improve understanding, or evaluate potential opportunities, also needs further evaluation within the design process. Higher level summary information views that are able to work with the growth in data and information sources, are seen as part of that response to create an efficient 'bridge' between information and knowledge.

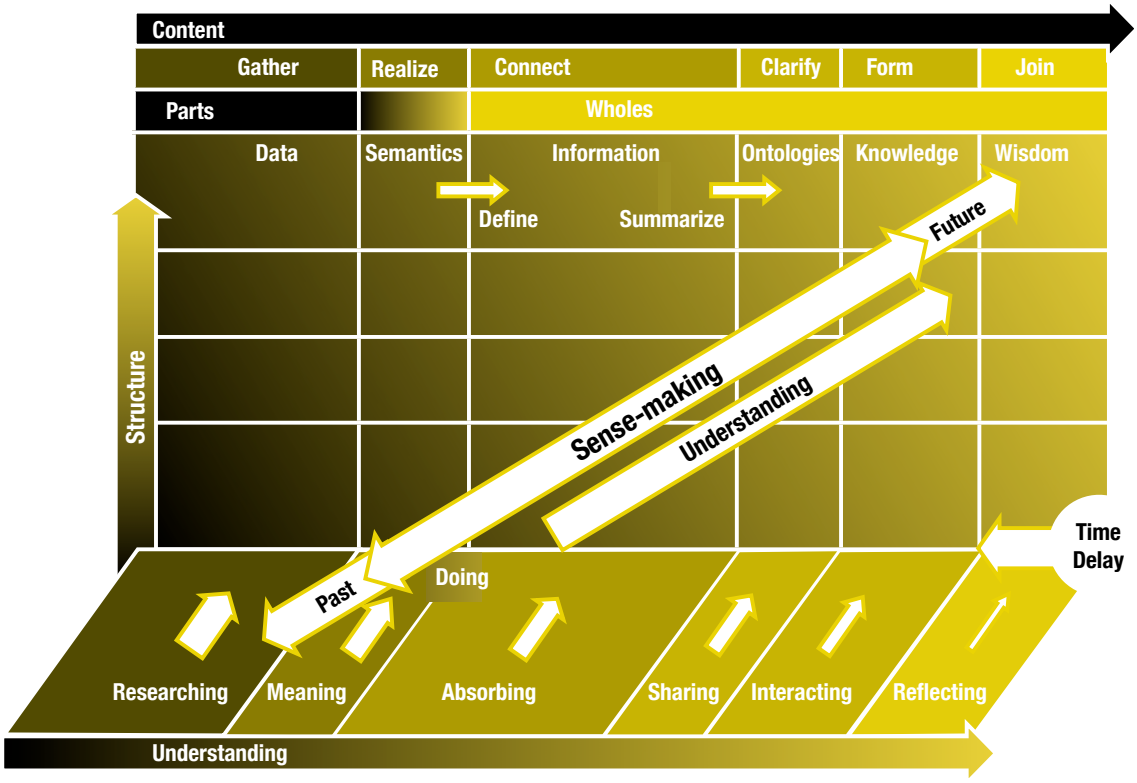


Fig. 10. Knowledge matrix [24] shows need for improved understanding.

Figure 10, illustrates where design needs to support the growth in information and bridge the gap with more effective and efficient summary tools that improve entropy. As data and information sources grow, designers need to continually evaluate the use of iterative design improvements upon existing solutions, as they become 'obsolete' because of technological change or inefficiency. Innovation within reporting systems also supports this growth, creating the need for critical design response. However, as Oram (2005) points out, there's no way in which design suddenly "transforms everything" (pp. 11).

4.1 Applications and Interfaces

It is often through interface design that applications are improved for users. As shown by Roberts (2004), *Information Visualization for Stock Market Ticks: Toward a New Trading Interface*. Roberts investigated the tasks that users do within equity trading, shown to improve human trading and understanding. The tasks were then 'mapped' against the information requirements.

24 Knowledge matrix based upon Hey (2004, p. 3), *'Figure 1: One view of the DIKW hierarchy (Clark, 2004)'.*

Roberts (2004) focused on user experience, measured performance, and analytical insight which led to the trading application interface.

Nielsen (2006) discusses applications and websites with 'progressive' and 'staged disclosure' to prioritise user attention. Nielsen suggests that, when working with 'conflicting requirements', the most simple frequently requested features should be delivered initially for 'simplicity'. 'Progressive disclosure' as Nielsen (2006) suggests, supports the revealing of advanced 'power' options upon request through additional screens, improving application learning (p. 1). Usability components with: learnability, efficiency of use, and error rate (Nielsen, J., 2006, p. 2) are also considered.

'Staged disclosure' however, is linear variant supporting defined steps (Nielsen, J., 2006, p. 4), therefore, less interactive. However, as Nielsen (2006) points out, both methods have their weaknesses (p. 4).

4.1.1 Existing Systems

Clearly there are many different examples of existing systems suited to information displays, such as various commercial broadcast TV systems, supporting realtime playout (e.g., *Vizrt*), or development tools (e.g., Apple's *Quartz Composer*). *Quartz Composer* was used for realtime experiments which would support realtime environments with integration into software design solutions, media segments, information display interfaces, and dynamic displays. As demonstrated by *DAF German Financial TV* (Fig. 17), *Quartz Composer* provided a suitable display output for its realtime Internet TV streaming solution.

4.1.2 Web Applications

Web applications are tools and services that are easily accessible and designed to be quickly understood by users by "gradual engagement" (Wroblewski, L., 2006). Good web applications should be designed with 'simplicity' in mind initially. It is often through "preconceived notions" (Wroblewski, L., 2006, p. 1) of simplicity, that builds initial engagement by users. For example, Wroblewski points out that Google search first appears very 'simple' from initial use. However, once the user becomes familiar after a few try's they can adjust their search strings to obtain better results. Wroblewski (2006) also points out that "perceived simplicity" may conflict with "actual simplicity" (p. 1).

A more specific example - online trading, is largely carried out with web applications (e.g., *E*TRADE, Schwab, Ameritrade* etc.). These store information within large

databases, and display 'live' or delayed market information to allow the user to make trades through their online account.

4.1.3 Desktop Applications

Desktop applications, use data stored within the computer, or through a connected network storage account. Support data. General personal finance applications (e.g., *Quicken*), connect to updated internet resources, then format the information using different visual reports.

The use of the GUI (Graphic User Interface) within desktop applications provides the user with a way to do tasks, and reflects changes within the users stored data file. Richer information displays, menu systems, and controls, continue to evolve and work more efficiently while improving the user's application experiences.

Support for different types of users needs can be achieved through "gradual engagement" to support both "average and power users." (Wroblewski, L., 2006, p. 5). As Wroblewski (2006) points out, designing for "gradual engagement" requires understanding of multiple types of users, states, and their context, and that simplicity may lead to penalising "power participants" (p. 5).

We often don't know how complex systems work, because of our own perceptions (Wroblewski, L., 2006, p. 1), labelling them as 'chaos' in a general way, but we also could simply interact with them. However, the balance of 'noise' and the alteration to viewer understanding provides.

Menu systems and other interface elements, support different input control devices. For example, presentation software is largely driven by simple 'click through' style controllers. Other information presentation examples make use of touch screen style navigation systems with enhanced user engagement - as shown by Han (2006), founder of Perceptive Pixel. Gestural displays have been part of research dating from the 1980's also featured in the more recent film, the *Minority Report* (Spielberg, S., 2002), Many interface elements which have been a large part of existing interface design, are not as visible on a constant basis within the design, and therefore provide new opportunities for interaction designers.

4.1.4 Mobile Applications

Mobile applications, run in a similar way to desktop applications. However, these often use a 'slimed' down system, offering a more ubiquitous approach to comput-

ing. Newly developed mobile services (e.g., M-Banking), may also support the development of future M-Trading applications.

Within the survey entitled *Internet Sapping Broadcast News Audience* (Pew Research Center for the People & the Press [PRCPP], 2000), the results showed significant use of well connected mobile and wireless technologies for viewers of financial news and Stock Market information (PRCPP, 2000, p. 2) and that technology supporting access to large range in information sources beneficial to investment decisions (PRCPP, 2000, p. 9).

New media devices aim for smooth seamless integration, combining different utility functions. For example, Apple's iPhone combines, phone, photos, web browsing, music, and other information 'widgets'. Different applications combine to share relevant information or data sets.

The iPhone multi-touch interface provides new gestural forms of interaction and 'rich' interface transitioning using motion, while supporting higher screen resolutions (160 ppi) - an inherent problem discussed by Tufte (1990) with the computer display (p. 89).

4.2 Information Design

With the development of new convergence devices, design to support information display needs to be considered further. Gregory Bateson in 1979, offered a definition of information as "any difference which makes a difference" (as cited in Wildbur & Burke, 1998, p. 6) by improving information through design. Wildbur and Burke (1998) define Information Design to include "selection, organization, and presentation of information to a given audience. Information itself can come from almost any source" (p. 6).

Information Design is a much larger 'umbrella term' than other specific design scenarios or forms (Hallock, J., 2005, p. 10). Hallock points out that:

> *As a field, Information Design relates to all communication products and experiences. It does this without dependence on medium and is primarily concerned with clarity and understanding. (Hallock, J., 2005, p. 14)*

Roberts (2004) includes Jacques Bertin and Edward R. Tufte (p. 10) as key figures that have "crystallized and formalized" the Information Design discipline and enhanced the practice of designing better presentations. In addition, Guns, Butter and Ballots, Citizens take charge by designing for better government (Emerson, 2005), provides examples to help define Information Design and what impact it can have. As Emerson (2005) points out, design is not a "trivial thing," but can enhance understanding (p. 16), with the ability to effect an economy on a much larger scale, therefore, seen as a "strategic resource" (p. 22).

> *It has all the methodology and analytical thinking that goes into the creative problem solving. Design is vital to the economy and to sustainability. (Samina Quraeshi as cited in Emerson, J., 2005, p. 23)*

It is important that the viewer can extract relevant information, with efficiency of communication as the "primary task" (Wildbur & Burke, 1998, p. 6). Furthermore, content should be "accurate and unbiased" (Wildbur & Burke, 1998, p. 6) without persuading the viewer.

The information designer, is also described as a 'transformer' (Wilbur & Burke, 1998, p. 6-7). Shedroff (1994) offers a more fuller description of a role in-which "information makes data meaningful for audiences because it requires the creation of relationships and patterns between data" (Shedroff, N., 1994, p. 4), whether that information is raw data, actions, processes, or visual models that have the ability to assist the audience with a better understanding of the topic.

Although both analogue and numerical modes can be incorporated together for information displays, the advantages, or disadvantages of either format need to be considered (Wildbur & Burke, 1998, p. 10). Consequently, creating "one of the greatest design challenges" requiring integration of "complementary modes of communication into a seamless whole" (Wildbur & Burke, 1998, p. 11).

Wilbur and Burke (1998) argue that speed of assimilation with analogue features (e.g., bar-chart, pie), is greater than pure numeric information (p. 10), however, numeric information provides greater precision. Changes in numeric information make it difficult to "assess both direction and rate of change" (Wildbur & Burke, 1998, p. 11) and therefore Wilbur and Burke (1998) suggests that it is possible to integrate the different modalities together equally well and provide examples of early statistical diagrams, most notably by J.H. Lambert (1728-1777) (p. 11), Swiss-German mathematician, and William Playfair (1759-1823), an English political economist (p. 12). In addition, it was Playfair who introduced the time-series graph, bar charts, pie charts, and

a variable-area diagram within, The Commercial and Political Atlas of 1786 and The Statistical Breviary, fifteen years later (Wildbur & Burke, 1998, p. 12) to support social and education aims. These formats were also able to display time-based information (Wildbur & Burke, 1998, p. 13). However, time-based change that is often part of animation, is difficult to reproduce in printed form.

Wildbur and Burke (1998), point out that increases in information sources (p. 16) require more "sophisticated means of selection and filtering and more structures presentations to make sense of it" (p. 16). This may mean that chart formats will become driven by new requirements (Wildbur & Burke, 1998, p. 17). In addition using design to "make sense" of "how things work" is also an important part of Information Graphics (Wildbur & Burke, 1998, p. 54), popularised by early cut-away engineering drawings and later on 1960's and 70's DIY guides (p. 55).

Visual devices used within printed illustrations include direction arrows as 'symbolic coding' (Wildbur & Burke, 1998, p. 73), exception states, pictograms, and other devices. However, Wildbur and Burke (1998) argue that pictograms cannot be considered as a "universal solution" for "cultural and other reasons" (p. 88).

Wildbur and Burke (1998), also discuss predictive and synoptic mapping, both commonly used for weather, however, synoptic mapping is suited more to 'professional users'. Simpler pictographic forms are created for the public (p. 151).

4.2.1 Static Displays

Within, Envisioning Information (Tufte, E., 1990), Tufte provides examples to illustrate information design principles and critiques various data representations. Tufte refers to earlier 'static' print based works to help illustrate the principles within; charts, diagrams, graphs, tables, guides, instructions, directories, maps, "to reason about, communicate, document, and preserve that knowledge" (Tufte, E., p. 33, 1990). However, as Tufte (1990) points out, these are all dependent upon two dimensional surface displays he describes as "flatlands" (p. 12).

Tufte (1990) suggests better methods for "enriching the density of data displays" (p. 33), with symbols, icons, dingbats (p. 26). The use of 'small multiples' provides the ability to store information variables within series; therefore, an important repeating design function to display high density information. As Tufte (1990) points out 'small multiples' are important because they support quantitative questioning; i.e., "compared to what?" (p. 67).

However, people must be able to comprehend the design and the related variables derived from the data. Once people understand one slice of data, they can

make sense of the remainder (Tufte, E., 1990, p. 29). Consistency within the design allows viewers to focus on change of information (Tufte, E., 1990, p. 29).

Furthermore, "data-thin designs" lacking in quantitative depth also "provoke suspicions" (Tufte, E., 1990, p. 32). Therefore, Tufte (1990) suggests that multifunction graphic elements (p. 47) within a design can lead to visual displays rich with data (p. 50). Tufte (1990) further suggests that with 'effective layering', a greater combined presence (p. 53) can be achieved. The use of annotation colour supports 'effective layering' through defining distinct layers of information as this provides a visual 'commentary'.

4.2.2 Dynamic Displays

Dynamic displays improve entropy with time series information. However, the overall experience of the viewer and the dynamic information need to be considered.

Information Interaction Design: A Unified Field Theory of Design (Shedroff, N., 1994) includes broadcast programming and interactive 'experiences' using dynamic information sources (p. 1) that also touches upon Sensorial Design. In addition, Shedroff (1994) points out that "information overload, information anxiety, media literacy, media immersion, and technological overload" need to be considered (p. 1). For this reason, newer 'smarter' dynamic information displays have the potential to reduce 'overload' or 'information anxiety'.

> *Our 'Age of Anxiety' is, in great part, the result of trying to do today's jobs with yesterday's tools with yesterdays concepts. (Marshall McLuhan, The Medium is the Massage, N.Y.: Bantam Books, 1967, pp. 8-9.)*

4.2.3 Streaming

Streaming differs from video on demand, as it supports 'live' playout of events. Moreover, streaming is an important part of delivering media and deals with the issues surrounding delivery of video footage to the end viewer.

Since the introduction of multimedia playback software for computers, such as the introduction of Apple's *QuickTime* (1991) and streaming capabilities later on, it was possible to deliver video clips over the internet. However, delivery of video clips was often slow to download and 'jerky' because of the limited frame rates available

for playback. As *QuickTime* and other similar formats progressed, streaming supported better resolution and display. Streaming media is more reliant on the bandwidth available, as opposed to terrestrial (analogue) broadcasting, and therefore more reliant on the device used for playback and display. New mobile phones make optimum use of streaming media and specific media formats (e.g., 3GPP), as the amount of information they can hold is limited.

Technological advances in video codecs, compression, bandwidth, software, and hardware have contributed towards improved playback quality. However, despite many early limitations, significant advancements with streaming media led to the ability to stream live video events over the internet. Furthermore, movies and television shows are now being made available for downloading on the internet (e.g., Vodcasts - Video Podcasts) and media portals (e.g., *Google Video, YouTube, Brightcove, Revver, Vodpod*).

Streaming Graphics

Streaming Graphics (Norton, & Wilkinson, December, 2000) deals with issues surrounding the delivery of realtime media and data. The benefit of streaming graphics is the support for live processing of information. The authors define streaming graphics as a "cross between streaming video and dynamic graphics" for real time information delivery. (Norton & Wilkinson, December, 2000, p. 1).

Norton and Wilkinson (2000) argue that streaming graphics are different from dynamic graphics that use motion to "reveal structure in static data." Streaming graphics support the display of summary information connected to real time data feeds and therefore suited to real-time monitoring processes including: manufacturing processes, health indicators, financial statistics, web data (Norton & Wilkinson, December, 2000, p. 1).

Streaming graphics involve processing the data before any visual change is derived from the sources used. Special algorithms for handling streaming data support a varied delivery context. Onscreen changes surrounding screen graphics connect through information attributes. The designer or developer must also know what ranges will the data fall between, and their translation into graphical change. 'Graphical listeners' - linked via multi-threaded data feeds update simultaneously to reflect any visual change. For this reason, realtime applications using streaming graphics, are governed by the advances in computational power needed to produce such graphics.

Streaming graphics are usually 'rendered' on the computer used for viewing the information. However, if the supply of data, or computational rendering is inter-

rupted, and no 'redundancy' is designed to be part of the graphical system, then this may have negative effect on the display playout.

4.2.4 Video Feeds

Video feeds may originate from different sources around the world. However, this was formally confined to the capabilities of television networks. Today, internet protocols and connections also support video feeds. Video can be generated easily and broadcast over the internet using different streaming formats (e.g., RTSP - Real Time Streaming Protocol). In addition, video generated as part of video conferencing supporting collaboration style applications has also largely contributed towards internet video feed content.

Internet TV has emerged as a result of different devices supporting video feeds, from various sources. This has led to the growth in 'topic specific' or 'niche' Internet TV community channels. How information can support video feeds is an important part to the conceptual prototype presented within this research.

4.3 News and Reporting

Within the article, *Design for the Sofa* (Jenett, D., 2000), Jenett looks at the convergence of the TV and internet. Jenett (2000) suggests that Broadcast Design, influenced by Web Design, has led to not only a convergence of technologies but also of design aesthetics (pp. 1). Convergence occurs when mass media broadcasting 'fuses' with the personal computer via an internet connection (Jenett, D., 2000, pp. 2). However, the form of this is still being debated, and explored through many formats.

Jenett (2000) points out that bandwidth is a 'temporary phenomenon' (pp. 3) and that therefore, both improved bandwidth, and efficient compression of media will allow more motion and impact on the internet (pp. 15). However, Nielsen (1997) suggests that computer-based Web will include more multimedia effects as bandwidth grows (p. 2), along with more powerful computers and image compression. Furthermore, the "avalanche of online video through the Internet" has led to the "Net Neutrality" (*Beet TV*, 2007) debate, also discussed by Tim Berners-Lee - Inventor of the World Wide Web. The issue of retaining 'equal access', and that content should not be controlled may effect the future of the Internet and the 'openness' it supports. Telco companies are contemplating a "two-tier Internet," with improved

infrastructure to handle the increased data - a result of delivering bandwidth intensive media, therefore also providing the opportunity for control.

Within existing television, enhanced programming, and interactive capabilities provide higher quality imagery and interactive experiences (Jenett, D., 2000, pp. 4). 'Backchannel' services allow TV shopping, and gaming. However, different interfaces will still 'confront' the viewer and impact upon any expectations, consequently leading to "physical shortcomings" (Jenett, D., 2000, pp. 8) and different interactive scenarios.

Designing for the appropriate interactive context or 'assumed job' requires an understanding of the "difference between functional interaction and entertaining communication" (Jenett, D., 2000, pp. 8), while also supporting the limitations of the SUI (Solid User Interface) handset. As Jenett (2000) suggests, different behavioural patterns require separate treatment and approaches which will mean that "time-based, passive, active, and interactive content will have to negotiate real estate." Furthermore, interactive content would require time management of media by the user, except during realtime coverage, subject to "choice, customization and reconfiguration." Therefore, Jenett (2000) claims that this may make the "broadcast world will be a lot more web-like" (pp. 9).

Broadcast Design in comparison, has an aesthetic and production value with certain expectations by the viewer suited to the display on large high quality TV's and displays. This has been largely due to many separate professions coming together through the convergence of media to bring about "clarity to the meaning and value of communication design as well as branding" (Jenett, D., 2000, pp. 11). The viewers recognition with any content and "subconscious habits" and other important factors help retains interest.

As Jenett (2000) points out, the challenge will be how the design will work with the different displays and how to "combine passive and active display of content" (pp. 13), viewing perceptions, distances, and environments. However, Jenett (2000) states that, higher bandwidth will allow for "communicating design rather than information display" (pp. 15).

In addition, Nielsen (1997) points out that different media has different uses. Television is about characters, movies are about stories, and that theatre is about ideas. TV, seen as a more 'convenient medium'. In comparison, movies lack series - characters are developed less and the film rests on a strong plot. Theatre is more experiential and about dialogue over visuals.

The activity required by the users, defines the difference between TV based Web and computer-based Web (Nielsen, J., 1997, p. 4). As Nielsen (1997) points out, the

Web on computers requires more interaction and initiative to provide empowerment to the user (p. 4) as opposed to the Web on TV that is more about integration with existing broadcasting, because less initiative is needed by the viewer (p. 4).

Television however, is still regarded as having a "substantial news and non-fiction component" (Nielsen, J., 1997, p. 1-2). This is not present within movies or theatre, due to the fact that television is better suited to live broadcasting of up to date news content.

The Web on TV (for enhanced interactive service), requires the system to be aware of the viewing context (Nielsen, J., 1997, p. 3) to provide useful information, such as Web enabled TV listings (p. 3), to enhance the viewers experience with applicable links to content). This could provide more efficient evening news with broadcasts optimised for the individual (Nielsen, J., 1997, p. 3). However, this model is less flexible than full Web browsing. As Nielsen (1997) points out, the Web on computers is a "very information-rich," (p. 2) as opposed to the Web on television, which should be more "user-driven and individualized."

As a result of the study, Nielsen (1997) further suggests that Web on TV still needs to incorporate design direction that is "better suited" (p. 2) to the device being used. Nielsen (1997) also provides a comparison chart for screen resolution, input devices, viewing distances, user posture, room, integrated opportunities, number of users, and user engagement.

Innovation within media devices leads eventually to the same media devices becoming 'obsolete' to use McLuhan's term. Both media and device convergence are influencing the way that information is delivered. With each iteration - improvements upon previous media are made. Media displays that retain or improve the 'value' or interaction, are becoming more dominant since the introduction of the Web. Feedback becomes an important part of the information display to provide a sense of viewing community.

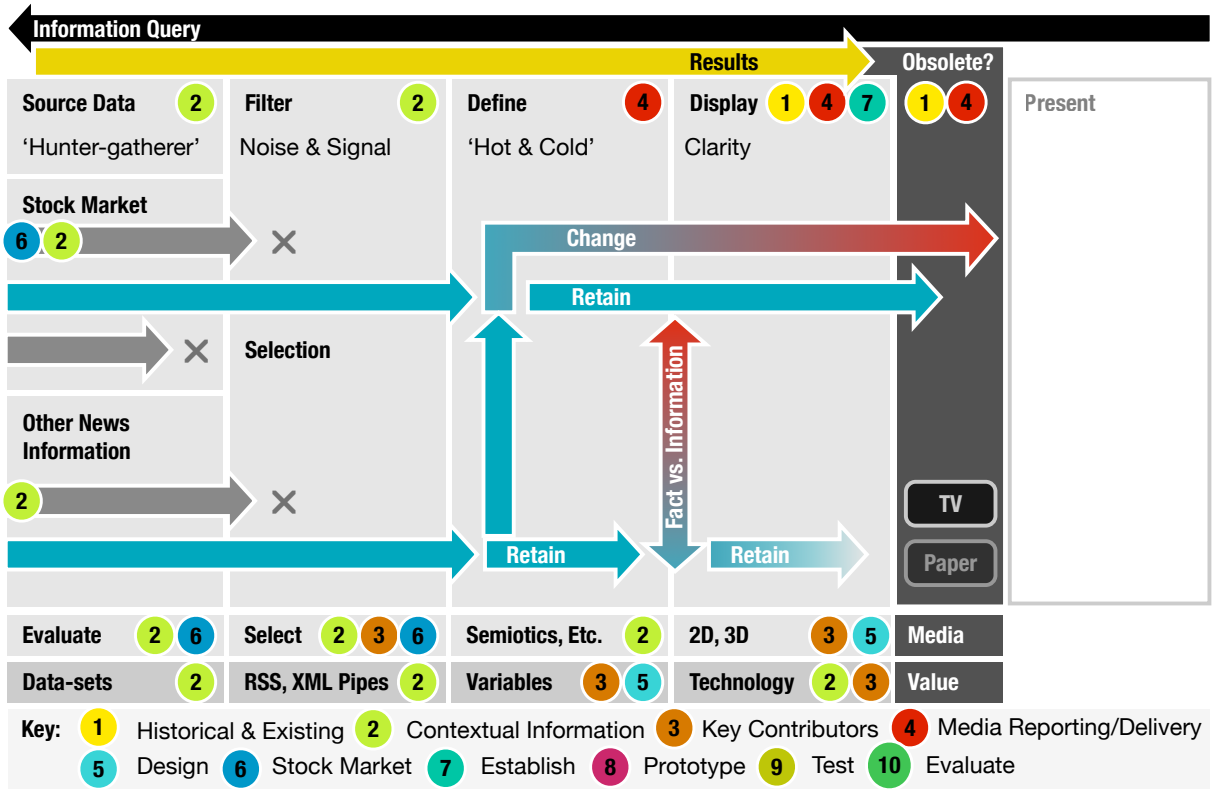


Fig. 11. Media and information becoming obsolete over time or due to newer technology.

4.3.1 Integrating Reporting

Many researchers have explored the issues surrounding integrated information with broadcast media, and the form in which it should take. For example *Beyond Broadcast* (Livingston, Dredze, Hammond, & Birnbaum, 2003) provides a prototype solution supporting additional information for viewers of broadcast news. Integrated TV, with the internet "satisfy the user's information needs" with related in-depth information to support news items. This demonstrates an example of an existing working model. However, design considerations for content have not been fully addressed. One key point made, is the "starting point" role that the TV has in providing summary news information to support further investigation by the viewer.

> *Instead of considering the broadcast news as the end product, this work uses it as a starting point to dynamically build an information space for the user to explore. (Livingston, K. et al., 2003, p. 1)*

Viewers watching news stories, can activate the 'interest' button for additional interest information to be fetched, and then displayed using a second supporting screen. The supporting information uses visual, textual information or pointers to other news website articles.

The *Cronkite* system (named after Walter Cronkite, CBS Evening News, 1962-81), classifies information as it processes it. Through this process - news broadcasts are broken down into the following categories: related coverage, opinions, in-depth analysis of the subject, explanation of key entities, general overview or background of the subject (Livingston, K. et al., 2003, p. 2).

The research by Livingston et al. (2003), concluded that with "very promising" results (p. 2), there was a need for more testing. This example shows that better contextual integration is possible, creating connections between TV and Internet based information sources. Therefore, TV still has a significant role to play in creating "starting points" for viewers to explore information further.

Fig. 12. Example of the 'Cronkite' system from Beyond Broadcast [25], (Livingston et al., 2003, p. 1).

This provided insight into a working system with connections to the internet for further information. This method is similar to that envisioned within the design outcome.

Within another example entitled *Integrating internet and digital video broadcast data* (Healey, Lalmas, Moutogianni, Paker, & Pearmain, 2000), investigate the "integration of broadcast and internet technology" (p. 1). Healey et al. (2000), similarly discusses the "convergence of broadcast and internet" (p. 1) along with the "challenges" for the user-interface design (p. 1-2). This presents a more technical focus

25 Fig. 1, *Beyond Broadcast*, http://www.infolab.northwestern.edu/infolab/downloads/papers/paper10119.pdf

upon delivery formats: DVB, MPEG-4, MPEG-7, with support for user profiles, preferences, and metadata objects.

4.4 Interactivity Design

Interactive TV solutions support higher quality footage, however, interactivity is limited. The inverse is true for Web based interactive solutions. One such interactive solution, Interactive Television or ITV, deals with issues surrounding the delivery of interactive media supporting higher quality footage with smarter broadcast services. ITV interaction is limited to the SUI (Solid User Interface) and has inherent limitations to the interactive experience. *Interactive Television Design Guidelines* (Withnell, J., 2006), provides suggestions for working ITV solutions that require an understanding of the 'passive' verses 'active' relationship viewers have with such media. As Withnell (2006) points out, this is because people are "typically relaxed" with a more "passive frame of mind" (p. 1). Therefore, Withnell suggests to make any service 'sticky' and retain viewer interest. Withnell (2006) also points out that "appealing creative design helps to engage viewers in a service" (p. 1), but should "not get in the way of content" (p. 1).

Interactivity within the design outcome uses display points to support contextual options. The presenter makes use of gestural navigation techniques combined with the display points. Viewer interactivity also uses contextual points with options, using transparent 'overlay' windows.

4.5 Narrative Considerations

Anything which maybe retold, supports narratives through the use of storytelling (Denning, S., 2001). Early origins of storytelling enabled humans to preserve practical information, lessons, morals, and history through rich oral traditions to maintain cultural information. The role of storytelling was not only to entertain but also educate and inform and enhance the retention of information within memory. Narratives take into account the occurrence or course of events and the related particulars.

Body language and gestures of the storyteller are still used as part of reporting today. The presenter provides gestures as part of storytelling to provide additional insight, historical context, occurrences and relationships to current events through fluid communication. This is all supported by broadcast footage and graphics.

The use of algorithm's and databases to support narratives is shown within the article entitled *Database as a Genre of New Media* (Manovich, L., 2000, pp. 6). Manovich points out that change with media and information, makes it difficult to retain narrative structures (Manovich, L., 2000, pp. 6). Manovich also discusses the concept of the "hyper-narrative." The design solution explores the role of the presenter through the interactive presentation by supporting 'traversing' of information, and multiple narrative 'trajectories' (Manovich, L., 2000, pp. 16).

Although there is large change within the market, once events occur, they become recorded market history. However, the way in which this information can be accessed may change depending on what type of narrative needs to be told.

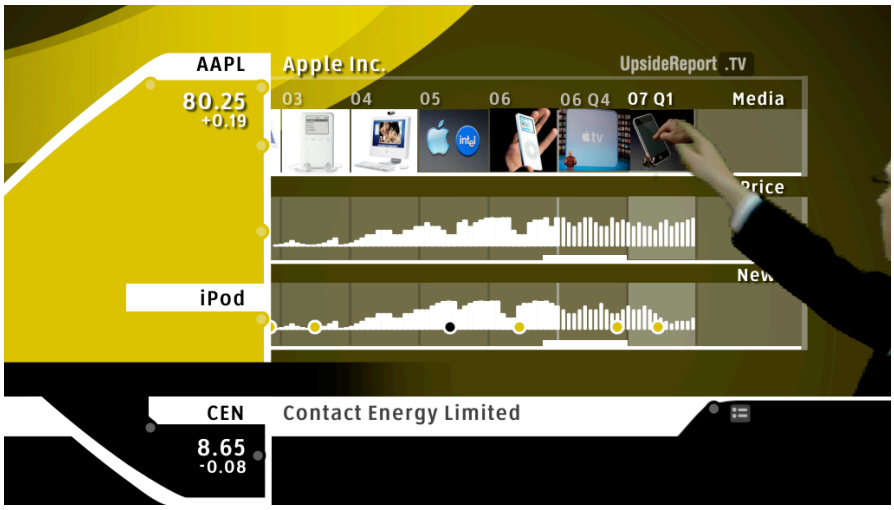


Fig. 52. Related media would also support search trend information to enhance the media relationship to stock information.

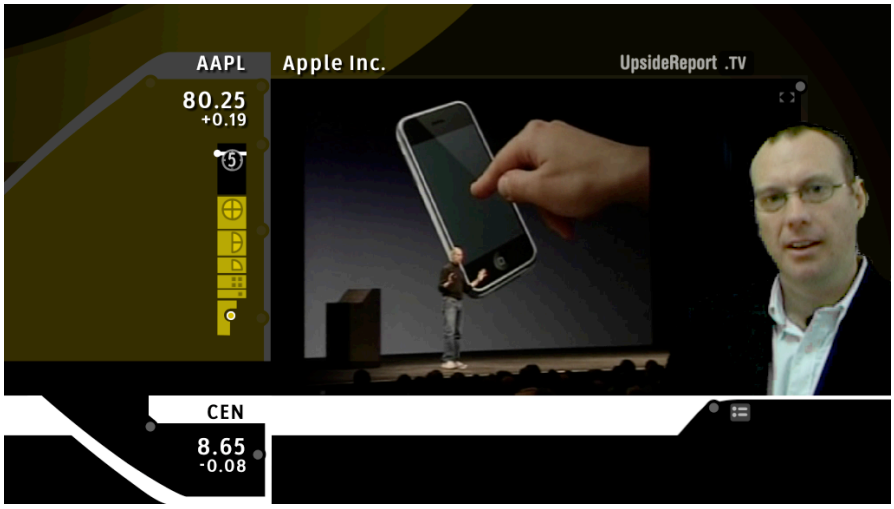


Fig. 53. Display supports the playback of related video clips.

Additional contextual information or visual material, supports market news story-telling though display interaction. Multiple keyframes provide visual timelines (Fig. 52) that can be accessed on an individual clip level (Fig. 53).

4.6 Presentation Sequence

The following sequence (Fig. 54) shows an example presentation sequence supporting wider 'macro' overview information (e.g., markets overall, industry sectors, fundamental information etc.), drilling down into focused 'micro' views of individual stock information (e.g., price change details). The non linear connections would also support additional presentation 'trajectories'.

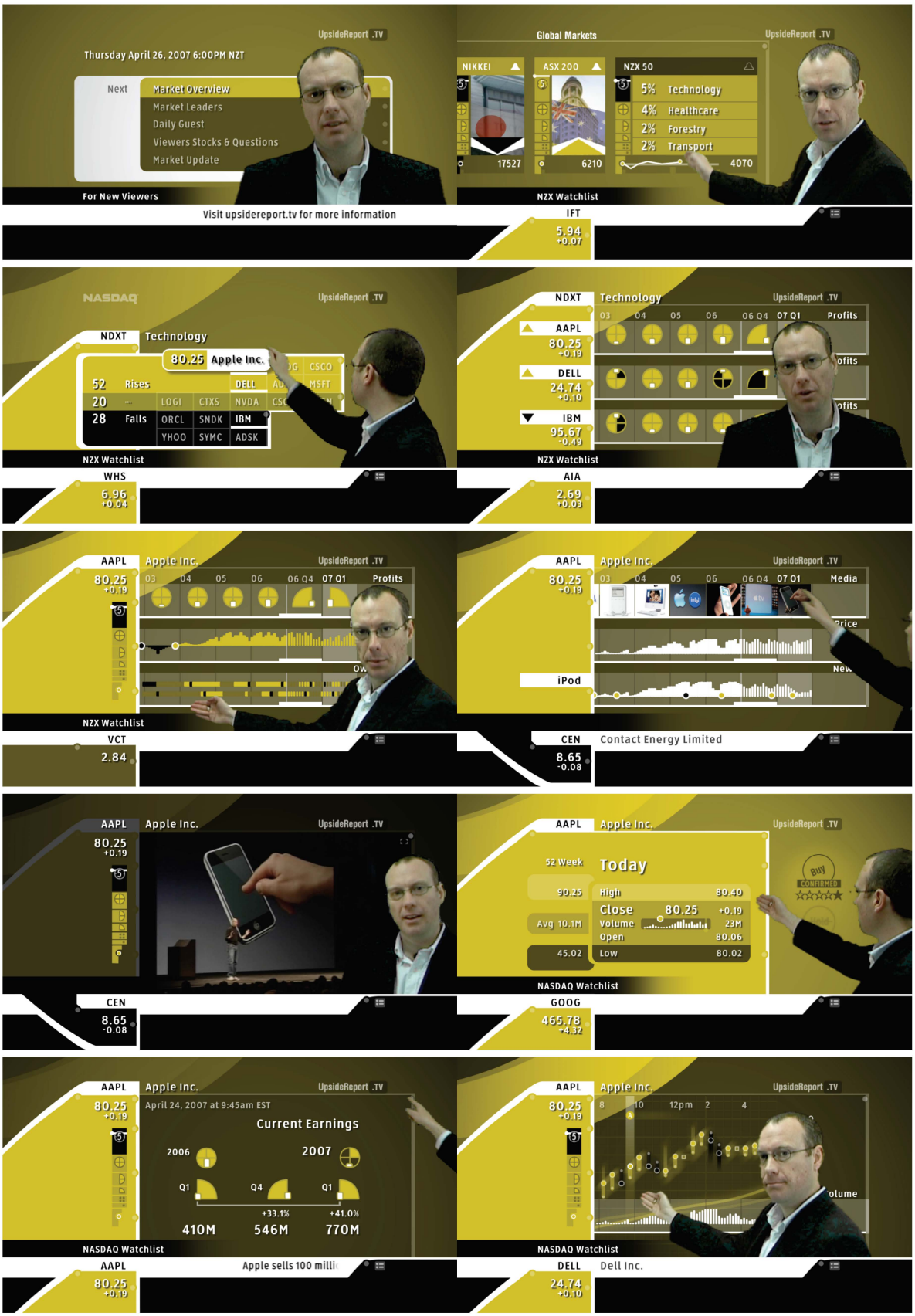


Fig. 54. Example sequence with presenter interaction.

4.6.1 The Concept of a "Market Story"

A market story containing daily events, may also contain historical events to provide contextual information. Market stories within broadcast media typically involve announcements for new products or services, earnings, and other news involving market reactions.

Within terrestrial broadcast market news, available footage assists with the visual communication of news stories. However, this is difficult with market stories with little visual footage for support.

> *Television reporters often face the challenge of making something out of nothing -- creating a compelling television story from an assignment that yields no decent pictures. (Newslab, 2006)*

News stories are formed from reporter's commentaries and available footage. Broadcast graphics have expanded that role to enhance the coverage of weather, sporting events and re-enactments through visual storytelling. Live footage, presenter commentary, and broadcast graphics communicate the unfolding of events as they happen.

To support news stories, market exchanges (e.g., *NASDAQ*), provide a physical information backdrop supported by additional broadcast facilities. Nasdaq *MarketSite* which began in 1993, created a physical presence in market reporting. Dynamic information on large multi-screen displays, appear in the background of market news reports. Company logos let people identify their 'favourites'. Within other types of reports - 'crossing' to an analyst or brokerage supports market stories, typified by trading room backgrounds.

The 'Spring board story'[26] format was also investigated, as this supports "catalyzing understanding" of how a "complex system may change." A jumping-off point similar to the 'starting point' role where viewers may act upon information.

Statistical Stories

Information within market stories is largely statistical in nature. Market stories are also part of the wider context of statistical stories. Formatting statistical stories requires attention to details within the information and how they are represented - while not distorting the perception by the viewer. Understanding how these differ from other types of stories is important. Statistical stories include numeric information, and results

26 See http://www.stevedenning.com/springboard_story.html

appear within weather, sports, economic, Stock Market reports etc. Results must be reinterpreted for the 'average person' to make them understandable.

Making Data Meaningful, United Nations Economic Commission for Europe [UNECE] (2006), provides guidelines for writing such stories. Contributing agencies and government bureau's around the world (UNECE, 2006, p. 4) attempt standardisation and 'best practice'.

Data is not just presented, but also turned into stories to provide awareness, perspective, context, and allow for informed debate on specific issues. Why someone would want to know the information is also important, as it must also be currently newsworthy and therefore suitable for news media. A statistical story, "conveys a message that tells readers what happened, who did it, when and where it happened, and hopefully, why and how it happened." (UNECE, 2006).

These types of stories, also require the viewer to engage with such information. As Emerson (2005) points out, literacy was "more complex" than they had imagined, due to the fact that it had to be accessible to both poor and that "graphs, icons, pie charts are more sophisticated than they'd thought, requiring a relatively high degree of visual literacy" (p. 16). In some cases, the use of language needs to be considered as Emerson (2005) points out (p. 17). However, this could be evaluated by user testing, as an important part of the process. This becomes important as designers work with various information sources containing words, numbers, and images to enhance overall communication. Furthermore, Tufte is also cited for his display suggestions including, 'data-ink' ratios and 'chart junk' (UNECE, 2006, p. 8).

Turning Numbers into Knowledge: Mastering the Art of Problem Solving (Koomey, J., 2001) also provides 'best practise' for using quantitative information. Koomey outlines his process through suggestions involving critical thought on how to "tell a good story" using scenario analysis, or "structured storytelling."

> *Quantitative problem solving is the process by which we take numbers and transform them into knowledge. (Koomey, J., 2001)*

Koomey's storytelling principles to support critical analysis include "identify [the] focal issue or decision" and "flesh out the scenarios" (Koomey, J., 2001, p. 108). It was through Koomey's principles that the concept of a flexible design to work with a variety of story scenarios.

Numeric information formatting for displays is also important. Suggestions by Nielsen (2006, April 16, 2007), have also been considered within the design solution for both viewer accessibility within summaries and typographic display limitations.

4.6.2 Integrating Change with Diverse Information

Dealing with diverse visual information sources and integrating that change can be a challenging task for developers. For example, *Towards a Non-Linear Narrative Construction* (Setlur, Hammond, Sood, 2003) looks at associations with media content and presents them to the viewer through a multi screen display to enhance viewing experience. Additional media and information (while the main parent movie is played) provide additional context through a user controlled non-linear narrative system. Consequently, it was found that most clips matched the last scene of the movie and therefore "a sign of a good movie" (Setlur, V. et al., 2003, p. 1). This is an important part of supporting automated composition of stories, reducing the need for human intervention within the editorial process.

4.6.3 Larger Narrative Arcs in the Market

Information that has been collected over longer time periods leads to longer term narrative considerations - constructed via multiple media and information sources. A non market example by Tufte (1990) containing 'macro' or 'micro' details (p. 57), creates a narrative by passing over a patients hospital information to derive what had happened to that person's treatment over time.

Market narrative considerations, similarly include both wider 'macro', and 'micro' details. Economic events provide contextual analysis to assist with the investor evaluation and influences market 'sentiment'. Narratives use large-scale contextual 'macro' views, while stories and announcements make use of small-scale 'micro' views. The size and effect of the events and stories that feature within the narrative time-line and the related success or failure, influences the current market sentiment by investors.

Larger market narratives that are of greater interest to viewers, are generally part of well-known public companies that have introduced new products, services, or well known CEO's. These factors contributing to larger market narratives may take years to develop through recorded events and financial reports (Jameson, D., 2000) within company trading history. Furthermore, connected events over longer term periods may feature company or outside influences that include; accounts, chronicles, history, descriptions, records, reports, stories and announcements that may influence the market in positive, negative, or neutral ways. Longer narrative considerations require evaluation against an investment method (e.g., *CANSLIM*). The *CANSLIM* method (*Investopedia*, 2006) combines both fundamental and technical analysis. Therefore, this is seen as a suitable 'balanced' method to evaluate information

needs supported by proven trading success. The *CANSLIM* method, chosen to evaluate information requirements for reporting scenarios, would support the viewers decision making. Similarly, other methods may further support the evaluation of market stories.

As discussed by Hallock (1998), the selection of information (p. 6) is important. Adopting a 'balanced' selection method was important to assist in qualification of information variables.

The *CANSLIM* (*Investopedia*, 2006) definition supports seven criteria;

C Current quarterly earnings
A Annual earnings increases
N New products, management, new events, new highs
S Small supply and large demand for a stock
L Leaders over laggard stocks within the same industry
I Institutional ownership
M Market direction

Although these elements may initially be released as individual stories, over time they become aggregated to form longer market narratives. Well established listed companies that introduce new products or other improvements to the market, typically show long term positive growth. For example, in 1997 Apple's (AAPL) Steve Jobs returned to the company, introducing successful new products and services, contributing to the positive longer term narrative that has had significant media interest to date.

To take another example, Google (GOOG) with strong dominance over internet searching and market share of online advertising revenue, has grown to a dominant company in the technology sector. Although Google (GOOG) is a relatively new company, it is closely watched by many investors as the growth leads to acquisitions of smaller companies through corporate strategy. In contrast, Enron after years of successful growth and the introduction of new services, company miss management led to a very 'short term' negative collapse (*CBSMarketWatch*, 2006). This shows a unfortunate narrative for those who were 'lucky to get out' or worse, simply asked 'what went wrong?', generating significant interest by the public. In addition, not only companies, but market indices (e.g., *NYSE, NASDAQ, FTSE, NIKKEI, ASX, NZX*), may also contain longer term narrative elements - influenced by larger economic environmental and geopolitical events.

4.6.4 Visual Elements with CANSLIM Support

The following table (Table 2), shows elements used within the design of the presentation sequence (Fig. 54). This shows the visual elements, signified message, design principles and *CANSLIM* variables to support evaluation.

Element	Signifies	Principles	Information	Supports
Basic				
	Positive Change	• Boolean	• Positive change • Fast Change	• Up • Yes • Open
	No Change	• Neutral	• Indecision • No Change	• No Change
	Negative Change	• Boolean	• Negative change • Slow Change (also white reverse)	• Down • No • Closed
Intermediate - Advanced				
	Positive Quarter	• Tufte - Small Multiples	• Quarterly result composite • Annual percentage change (see Figure 35 & 47.)	• CANSLIM (C)
	No Change			
	Negative Quarter			
	Positive Annual Result	• Tufte - Small Multiples	• Annual result composite • Quarterly clockwise trend (see Figure 47.)	• CANSLIM (A)
	Negative Annual Result			
	New products, management, new events, new highs	• Tufte - Small Multiples	• Significant Announcement	• CANSLIM (N)
	Company size (Market Cap) vs. Trade Volume	• Relative Comparison	• Liquidity • Company Size (see Figure 48.)	• CANSLIM (S)
See Figure 47.	Leaders over laggard stocks	• Tufte - Small Multiples • Comparison	• Leader Comparisons	• CANSLIM (L)
	Positive Inside / Outside Ownership	• Tufte - Sparklines • Comparison	• Inside ownership • Outside Institutional Ownership	• CANSLIM (I)
	Negative Inside / Outside Ownership			
	Positive direction	• Tufte - Chart-Junk, Sparklines • Movement	• Movement • Trend • Patterns	• CANSLIM (M) • OHLC
	Negative direction			

Table 2. Analysis of visual elements to support storytelling and evaluation.

4.6.5 Smaller Scale Iterations

Within other smaller 'storytelling' examples, researchers are looking at making information easier to relate to. This also leads to Interaction Design that is a 'derivative' of Information Design to support "story creating and telling" (Hallock, J., 2005, p. 8), and is not dependent upon any particular medium.

As Hallock (2005) points out that storytelling used for thousands of years, may support new forums when combined with newer technology (p. 8). Hallock (2005) argues that Information Design is related, because the designer tells stories through communication (p. 8). Through design, stories may "translate more clearly to the recipient" (p. 8).

> *Using information as a tool to tell a story may help people understand (consciously or unconsciously) the magnitude and importance of the information. Organizing information based on a story can provide a powerful end result. Organizing information with the traditional tools (e.g., alphabetical, numerical, etc.) can make the information impersonal. (Hallock, J., 2005, p. 9)*

As shown by *Storytelling and the personalization of information* (Moldenhauer, J., 2002/2003), Moldenhauer investigates "visual and verbal characteristics of information," analysed to create "user based designs" (p. 230) using storytelling methods. Similarly to Tufte (1990), Moldenhauer (2002/2003) argues that it is a mistake to believe "that simplicity and brevity equals efficiency" (p. 230).

In addition, Moldenhauer (2002/2003) suggests that Information Design should be a more 'personal' experience (p. 230), besides "organising our experiences" (p. 231). Consequently, Moldenhauer believes that the designer should ask the following questions when dealing with information: "What is the point of the information? Why does it exist? How, when, where, and by whom is it used? What sequence of steps is needed to extract the information?" (Moldenhauer, J., 2002/2003, p. 232).

As a result of Moldenhauer's study, appropriate methods for teaching user-based information design were explored further to include issues surrounding 'empathy' (p. 242). The design solution also considers these issues, 'personalisation', and questions the use, and point of the information.

5. Design Solutions

Existing solutions combine several functions to create market reports. These functions include information collection, organisation, and display. Existing solutions (e.g., *Bloomberg*), have developed techniques to effectively process information.

Within existing solutions, there is a large difference in the amount of information presented. For example, television news reports, largely contain short views of summary information. Database driven websites contain larger amounts of detailed information that often 'overwhelms' the user with detail. The integration of media technology offers the potential to explore synthesis of information and dynamic summary views in a more effective way using time based media.

The design solution is not designed to provide an aggregated information channel supporting 'personalisation' through Internet TV delivery. Support for interest and early evaluation of market information provides the primary objective in information delivery, while providing some basis for similarity to existing solutions. In addition, a more flexible interface with improved information relationships and the support for discussion 'points'.

5.1 IT Integration and Reporting

Aggregated financial data and news, using a similar process to that discussed by Bloomberg (1997) would support the design outcome with automated integration with market information. Existing IT Integration is largely carried out through news, and trading solutions connected to various data providers.

How the reporting is compiled, is becoming increasingly blurred as automated syndication is used to deliver up to date information. Due to the growth in support for syndication formats (e.g., RSS; Really Simple Syndication), more news publishers are making their content available to others through blog formats, news feeds. Aggregated RSS services (such as Yahoo Pipes), provide personalised tools to customise RSS feeds for experimentation, while also making available content 'pipes' to others. However, using other tools (e.g., 'screen scrapers' or 'bots'), to collect news information and recompose it in different ways (also known as 'mashups'), from the original context, has led to the online news editorial debate.

The emergence of Vodcasts (Video Podcasts for iPod/Zune using RSS enclosures) and (VOD - Video On Demand), has further contributed towards 'democratising' the reporting of news, information, and events. Existing broadcasters are also faced with making content available online (e.g., *TVNZondemand*). Semantic structures of syn-

dicated information (e.g., publisher, content, time) used to support RSS enclosures of Vodcasts, are an important part of maintaining timely up to date information.

5.1.1 Multiple Device Integration

Multiple device use has increased media accessibility. Both designers and users may need to become familiar with switching environments. Within *Design Issues for Dual Device Learning: interactive television and mobile phone* (Pemberton & Fallahkhair, 2005) Pemberton and Fallahkhair (2005) investigate user switching between multiple devices, depending on the role needed, thus drawing upon the strengths of each technology (p. 1). As Pemberton and Fallahkhair (2005) point out, designers face new challenges to create a coherent consistent experience for the user (p. 1). However, the user must be familiar with different devices and identify related services, therefore, branding plays an important role to "help the user develop a clear mental model of the service" (Pemberton & Fallahkhair, 2005, p. 5). In addition, the way in which each device is seen by the user is also important. The devices used by Pemberton and Fallahkhair (2005) include mobile phones - commonly seen as a "companion device" (p. 1). The television however, is "not normally perceived as a companion technology" (Pemberton & Fallahkhair, 2005, p. 2), and often part of group viewing activity.

The television medium offers an experience known to support learning (Pemberton & Fallahkhair, 2005, p. 2; Koskinen, 1996; Sherington, 1973), which may also take advantage of 'enhanced TV' modes and delivery on mobile devices.

According to Pemberton and Fallahkhair (2005), design constraints for interactive television and mobile environments need to be taken into consideration (p. 4). Stereotypical displays use 'L' Shape menu designs, or using semitransparent overlays (Pemberton & Fallahkhair, 2005, p. 5). However, mobile information typically uses the complete screen to maximise information display.

Vertical interactive navigation is typically limited to two or three levels (Pemberton & Fallahkhair, 2005, p. 5) with horizontal navigation between some sections. This must balance against negative effects experienced by the user such as "latency delays" (Pemberton & Fallahkhair, 2005, p. 5), resulting from multiple level navigation. This limits interaction, because the remote control handset with specialised function buttons restricts interactivity (Pemberton & Fallahkhair, 2005, p. 5).

It is evident that a clear trend exists in multiple device integration to create 'everyware' (Greenfield, A., 2006) experiences. Seamless delivery in information applications and products on mobile devices would take advantage of richer application interfaces with improved user engagement.

A solution delivered to a desktop style computer display or 'media center', could adjust to mobile delivery. Internet TV, has the potential to support greater feedback methods.

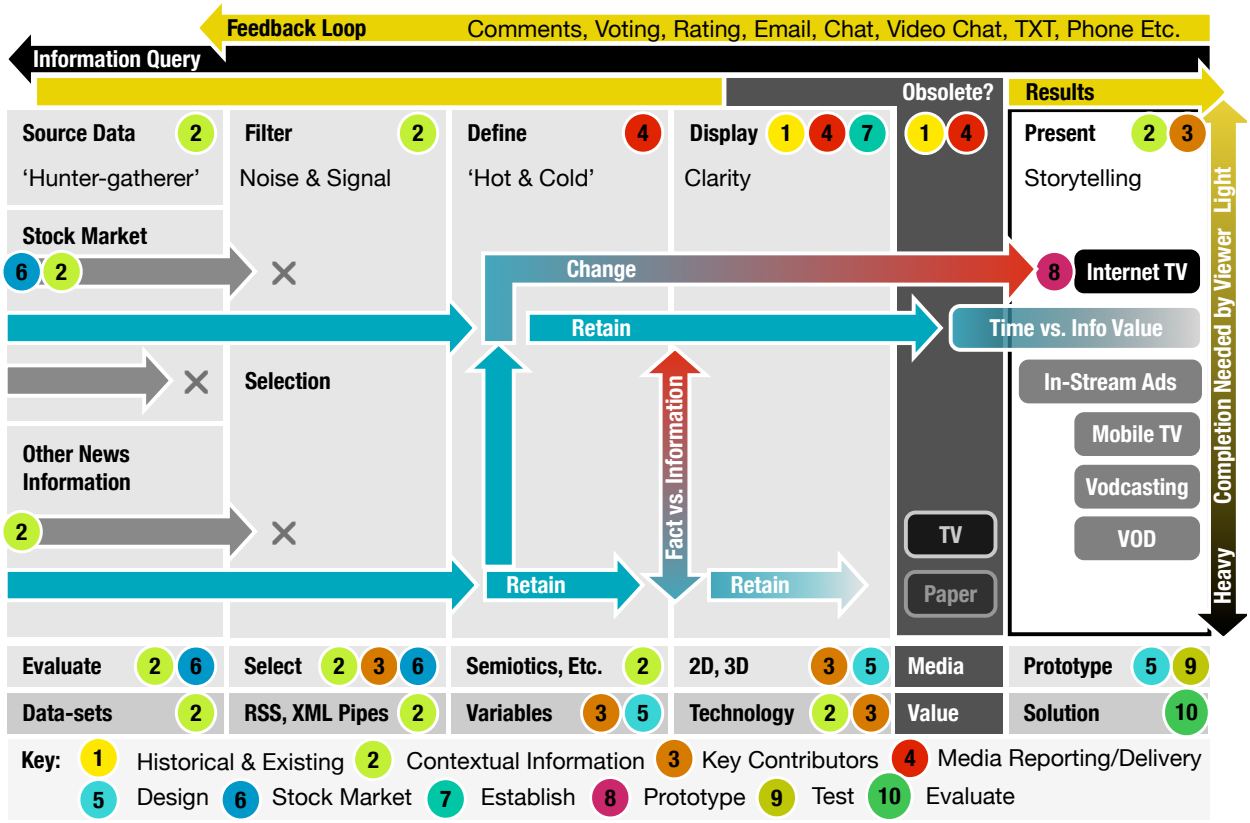


Fig. 13. New displays to support information storytelling

5.2 News and Information Design Integration

As, Lloyd (2004) points out, the greatest effect of design technology within broadcasting is that of the news and the role in which news graphics support stories (p. 5) and used within broadcast news, newspaper articles and interactive display graphics on the internet. Similarly, information design within news provides clarity to communication of the story and supports additional contextual relationships for viewers. Inevitably, this leads to media convergence as the newer 'medium' assimilates the old, however, the form in which the 'message' takes, continues to be debated.

To support my research, evaluation of existing information screens supports the research aims. The aim of this was to further understand similarities and differences between displays. In addition, 'stereotypical' graphics for Stock Market reporting, provides a 'baseline' to support the evaluation of new solutions.

Information Design provides a greater role in supporting consistency within design, therefore, suited to news displays supporting critical evaluation. As commonly seen within weather information 'plinth[27]' displays, constrained information 'multiples' support reading in an efficient manner.

27 Plinths provide backgrounds to support readability against backgrounds within information displays.

5.2.1 Market Reporting Stereotypical Information Displays

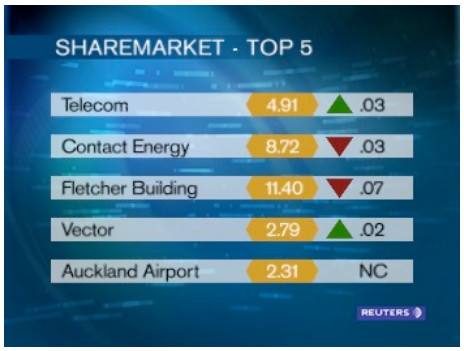


Fig. 14. One News TVNZ, NZ

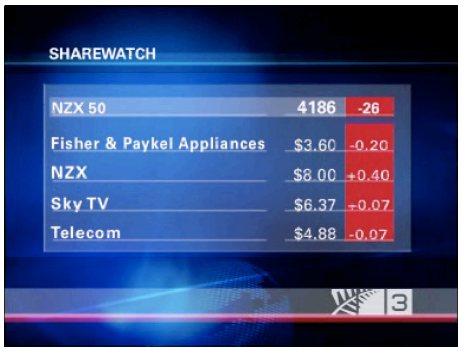


Fig. 15. TV3 News, NZ

Fig. 16. ABC Business, AU

Fig. 17. DAF, DE

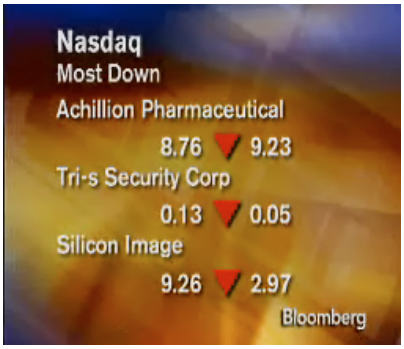


Fig. 18. Bloomberg, USA

Fig. 19. Traders Nation, USA

Fig. 20. RBC TV, RU

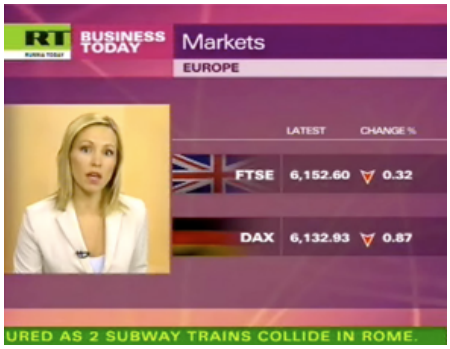


Fig. 21. Russia Today, RU

5.2.2 Market Reporting Visual Comparison

Reporting Channel	TVNZ TV1@6pm	ASB Business TVNZ	TV3	ABC Business	DAF	Bloomberg	Traders Nation	RBC TV	Russia Today
Country	NZ	NZ	NZ	AU	DE	USA	USA	RU	RU
Design									
Colour									
Market Up	▲	▲	+	▲	▲	▲	n.a.	▲	▲
Market No Change		n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Market Down	▼	▼	-	▼	▼	▼	n.a.	▼	▼
Uses Plinths	✓	n.a.	✗	✓	✓	✗	✗	n.a.	✓
Uses Screens	✓	✓	✓	✓	✓	✓	n.a.	✓	✓
Motion/Transitions	✓	n.a.	✗	✗	✓	n.a.	✗	n.a.	✓
Information									
Stock/News Ticker	✗	✓	✗	✗	✓	✗	✗	✓	✓
Basic Chart	✓	✓	✓	✓	✓	✓	✗	✓	n.a.
Detailed Chart	✗	✗	✗	✗	✗	✗	✓	✗	n.a.
Live Information	✗	✗	✗	✗	✓	✓	✓	✓	✓
Interaction									
Presenter/VO	✓	✓	✓	✓	✓	✓	✓	✓	✓
Present to Chart	✗	✗	✗	✗	✗	✗	✓	✓	n.a.
Analyst/Co-Host	✗	✓	✓	n.a.	n.a.	✓	✓	✓	n.a.
Feedback/Audience	✗	✗	✗	✗	✓	✗	✓	n.a.	✗
Delivery									
Video On Demand	✗	✓	✗	✗	✗	✓	✓	n.a.	✗
Streaming Internet TV	✗	✗	✗	✗	✓	✓	✓	✓	✓

Table 1. Existing comparison with online market reporting.

Observation for selected reports, made between July 2006 and January 2007 showed that some items could not be confirmed (due to random sampling), therefore, 'n.a.' has been assigned. Information based upon Stock Market reporting only.

Display

As Tufte (1990) points out, when information design works well, it can become "invisible" (p. 33) with more focus upon content data instead of the containers which Tufte calls 'chart junk' (Tufte, E., 1990, p. 33; Koomey, J., 2001, p. 166). Tufte (1990) provides an example by Pugin who argues that it's "ok to decorate construction but not construct decoration" (p. 34) to support his argument. Koomey (2001) also discusses Tufte's principles and offers many practical suggestions take into consideration frameworks suitable for future news scenarios and prepared in advance.

Where possible, enhancements with the display of the variables within 'containers', assist with the communication of market direction, and access of information segments in a non-linear way. This is to allow the presenter to 'guide' the display with greater interaction.

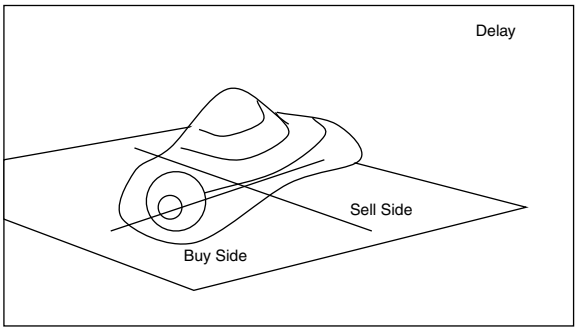


Fig. 22. 3D Exploration

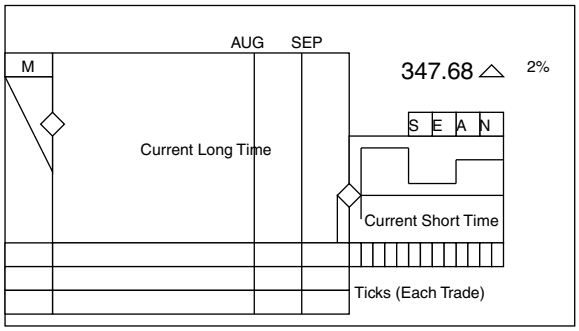


Fig. 23. Traversing Time Scales

Earlier display concepts incorporated 3D elements (Fig. 22), which later shifted towards showing relationships with 2D representation as there was little apparent benefit for 3D. Later designs investigated the use of 'macro' and 'micro' (Tufte, E., 1990), views for 'traversing' from wider contextual information. However, these were dropped due to issues with flexibility within the display environment. It was found that there was a need for additional screens (Fig. 24-25) to show information that could be achieved by using fewer, more adjustable screens, within later designs (Fig. 26-27).

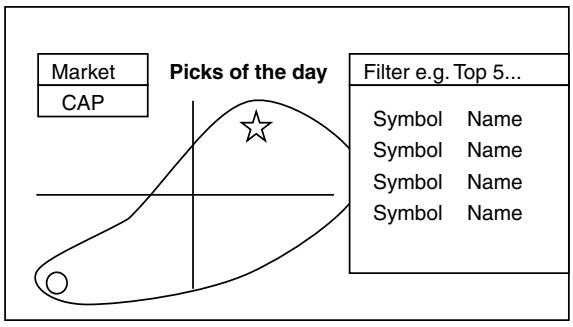


Fig. 24. Bubble Graph Style

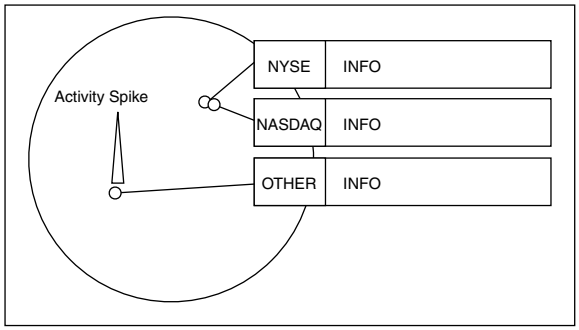


Fig. 25. Linked Menus

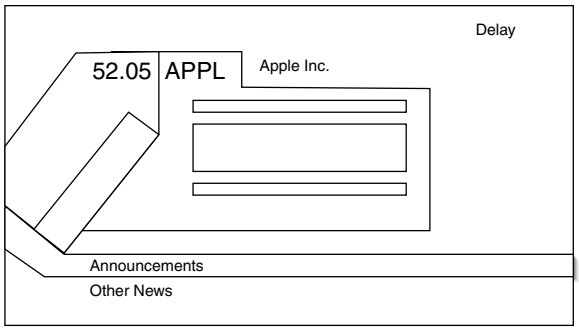


Fig. 26. Early 'Tool' Display

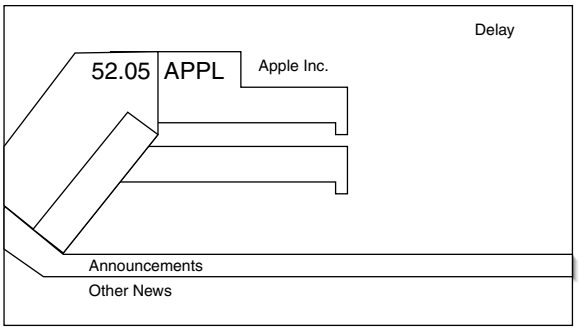


Fig. 27. Early 'Tool' Multi Display

The 'F' based design also supports natural readability and eye tracking (Nielsen, J., April 17, 2006) for information. This also provides the presenter with more freedom to explore information quickly as events unfold or as audience participation requires with additional 'starting points' for further discussion.

Grids

The design solution aimed to incorporate a suitable grid to support the revealing of menu and information screen sequences. 'Progressive disclosure' for both the structure of information and presentation sequencing is also supported. A broadcast style widescreen 16:9 modular grid supports retractable information displays that change depending on the presentation needs. In addition, the widescreen modular grid would also support cropping to 4:3 display ratio without loss of key information areas.

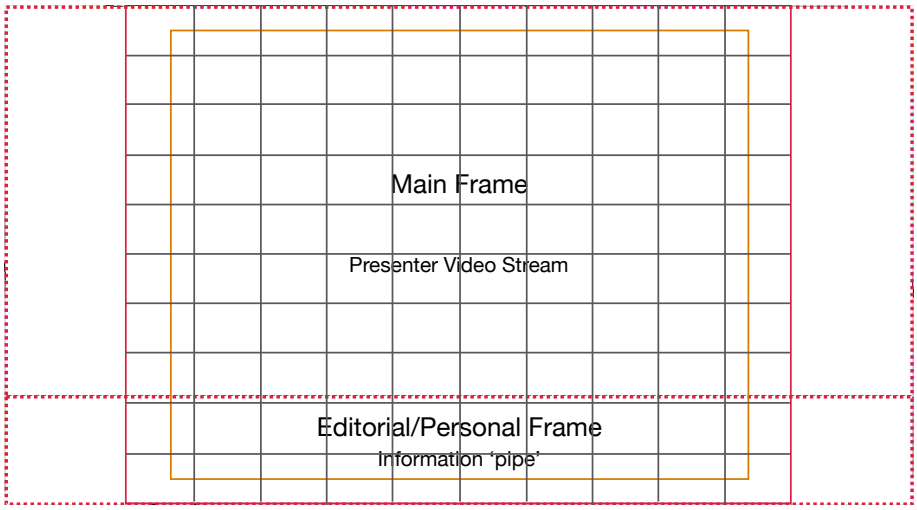


Fig. 28. Example of main layout areas.

The alignment of information within the retractable displays is 'synchronised' with others through 'small multiples' of information (Tufte, E., 1990), including video key frames. This is achieved with a column based grid, connected through organic tran-

sitional movements supporting ‘drill downs’ or ‘traversing’. The use of constant positioning, where possible for information variables to display market symbols, name and price information, reduces visual disruption between transition states. This also shows little disruption to the overall display. Follett (2007) also points out that this “closely resembles physical reality” (pp. 16). The use of ‘transitions as design elements’ (Follett, F, April 26, 2007), plays an integral part in delivering compact information sequences where “narrative elements such as timing, pacing, and rhythm increasingly important.” (pp. 2).

Alignment of elements within the grid, show information relationships for organic changes between screens and sub displays. The ‘figure/ground’ relationship’ with background elements provides ‘ambient’ information, as opposed to the foreground showing both historical and current information. Similarly, the ‘Tetrad’ discussed by Mcluhan, helps see both figure and ground relationships.

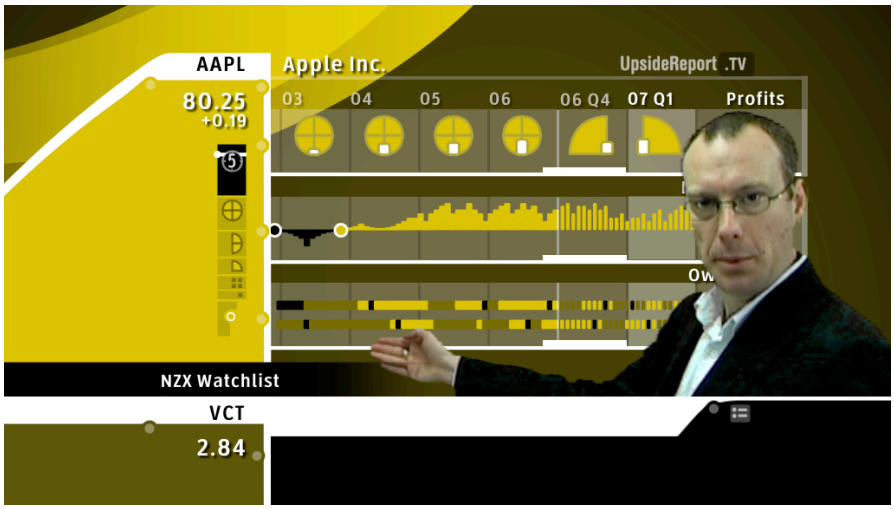


Fig. 29. Interactive display extends, retracts, and allows for content switching.

Hierarchies

Presentation hierarchies used to help with both navigation and information display. Navigation hierarchies draws upon hyper-navigation 'traversing theory' (Lemke, J., 2001, pp. 15). This provides greater presenter interaction, while forming a 'organic' hierarchy to show harmonious natural relationships between screens. This provides a different approach to existing presentations that use hard cuts between graphics where little or no information remains between each screen.

Within each display state, information hierarchies were evaluated for improving 'quick scanning' (Emerson, J., 2005, p. 14), Emerson points out that improved hierarchy of information and other summarisation techniques could improve quick 'scanning' of key points (e.g., a colour coded level status). A clear hierarchy communicates the most important information.

Suggestions by Emerson (2005) support the hierarchical nature of the information, which also governs relationships in the display interface. Understanding the hierarchy of information became important to support the viewers evaluation process.

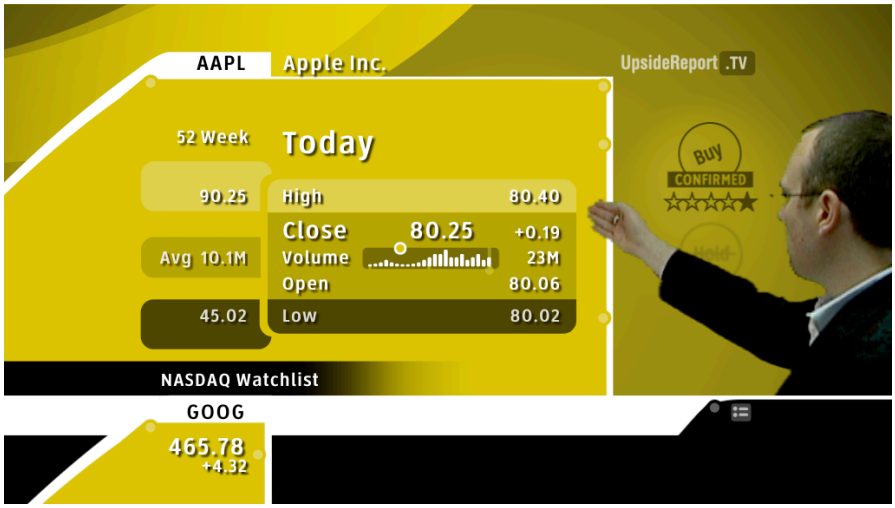


Fig. 30. Information display with positive price movement (OHLC format).

Figure 30, shows a typical example of daily information, however, visual difference in price does not follow logical order within positioning hierarchy. Change is also difficult to understand in context to historical movement. The design outcome adopted the OHLC (Open, High, Low, Close) format for screen information elements. In addition, elements are only visible if price action triggers them while also changing the display to show market direction. This reduces redundant information on days with little change.

Some viewers may need time to adjust to the display. However, due to the repetitive nature of reports - and 'learning effect', this is not seen as a significant issue.

5.2.3 Information Hierarchy

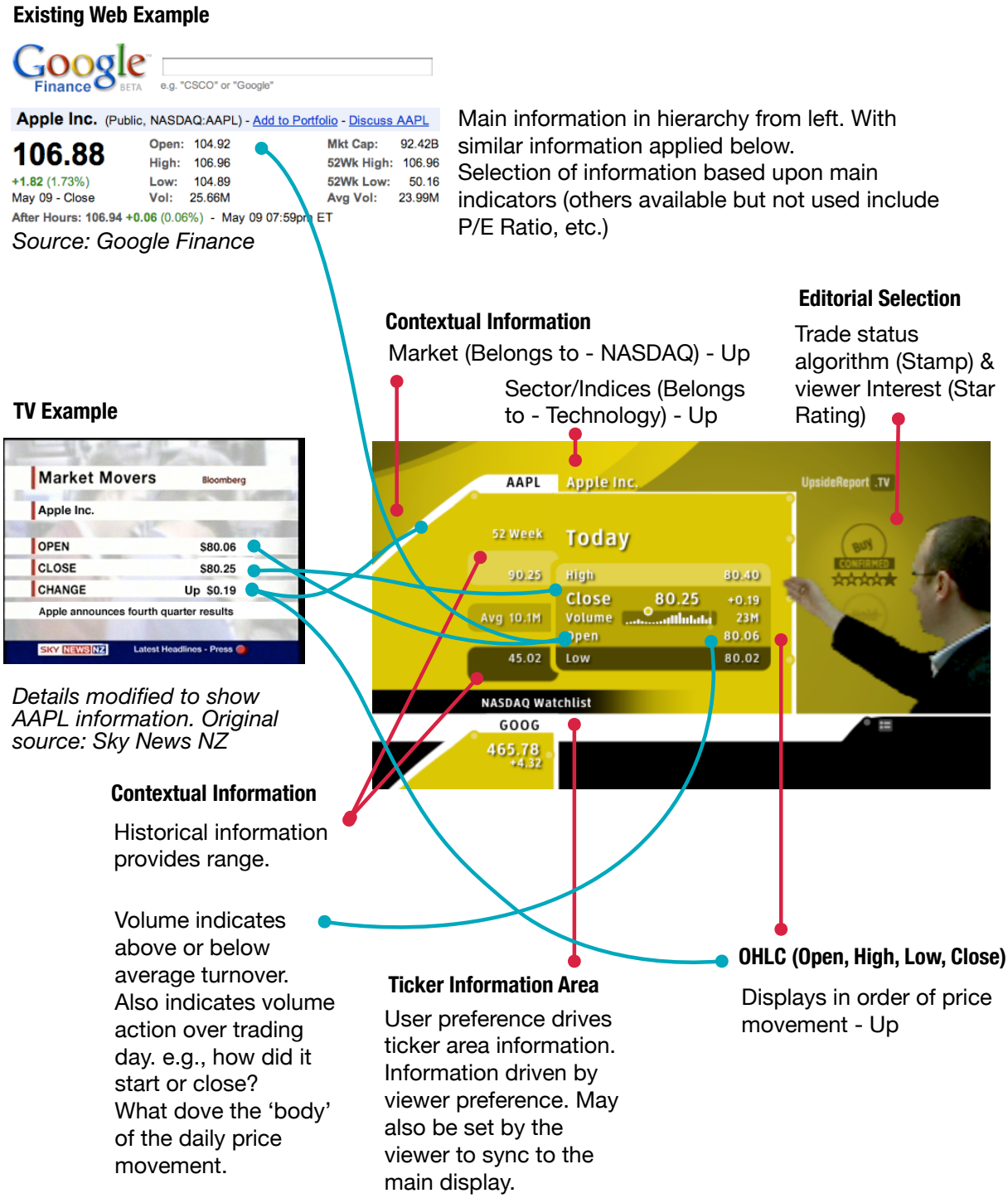


Fig. 31. Display breakdown using Web (Google[28]) and TV[29] comparison.

28 Example from http://finance.google.com/finance?q=AAPL

29 Example from http://www.nztvpres.info/skynews/06au3.php

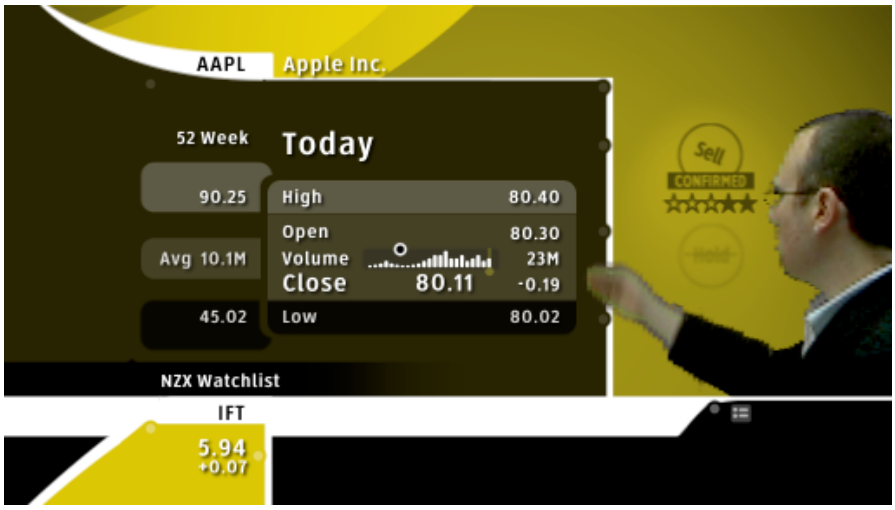


Fig. 32. Layout trial showing information display with negative price movement.

Fig. 33. Layout trial showing information display with no change.

Position

The positioning of information within a composition helps with communication, through logical placement. Tufte (1990) also showed that positioning of information could also enhance meaning (p. 46), and that separation with white space needs consideration.

Within the design solution - the positioning of information is determined by the 'side of the market' that it belongs to and the relevance it has to the information close by.

The layout position considers the presenter location. Larger space on the left, and right hand side of the screen supports the presenter.

Scale

Media streaming often uses repurposed larger format content that is re-scaled. However, this may lead to negative display effects (e.g., unreadable screen typography due to down scaling). The display of streaming media is largely reliant on the quality of the compression applied, and therefore may show 'artifacts' on larger displays.

Shape and Form

Shape and form plays an important role within design and communicating information. Within *Watches Tell More than Time: Product Design, Information and the Quest for Elegance* (Coates, D., 2002), Coates (2002) discusses several methods to allow designers to "make sense" of design (p. 31). For instance, one of which discusses information contained within shape. This may include, contrast, novelty and stereotypical forms analysed against existing solutions with semantic profiles (Coates, D., 2002, p. 231).

Coates (2002) became "drawn naturally to see matters in terms of information theory; wherever there is form, there is literally information" (p. 51), and points out that information contained within form includes: Essential, Collateral, Discretionary (p. 112), along with derived meanings (contrast, novelty, stereotypes) (p. 122).

Fig. 34. Adjustable tools and organic form as the conceptual synthesis.

It is also through the exploration of shape - not only to communicate the information, but also support the display of it, that led to the asymmetrically weighted hierarchical interface design. The shape of the interface also denotes the market direction and dynamically changeable. Early exploration into the interface design led to the hybridisation of inorganic tools and organic forms to create a synthesis of ideas. This type of display also supports 'progressive disclosure' by allowing for different 'levels' of information to be introduced over time.

As discussed by Saffer (2005) within the thesis entitled *The Role of Metaphor in Interaction Design*, the metaphor should fit into the functionality (p. 23). For this reason, the interface design supports abstract shape to suggest market change instead of using literal metaphors.

Conceptual testing showed that the metaphor applied to the design outcome is 'fairly' transparent, and therefore confirms the recommendation by Saffer (2005, p. 24).

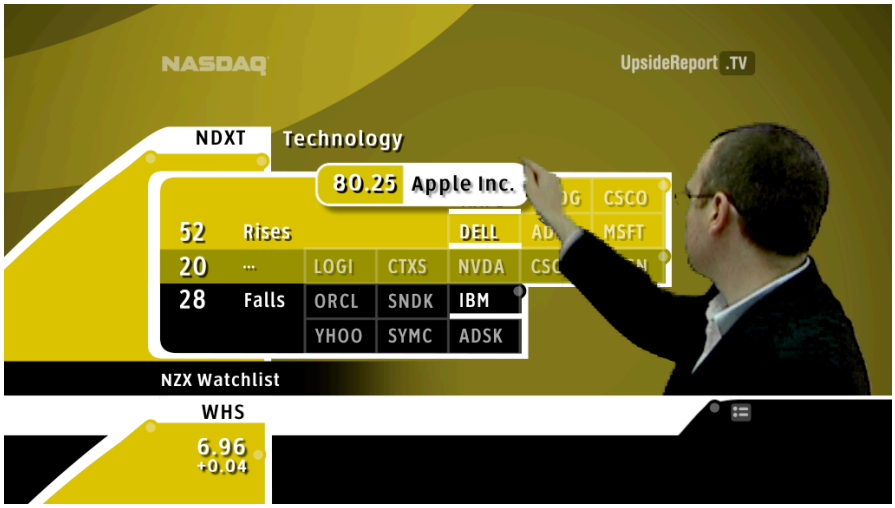


Fig. 35. Shows use of form within the layout to suggest market direction.

Evaluation of shape to communicate information led to the creation of symbols supporting the display. For example, the annual result information required symbol creation. The concept of 'quarters' is communicated, while displaying the associated change to promote "simpler reading" (Tufte, E., 1990, p. 51). The 'data-intense, design-simple' principles by Tufte (1990) condense large sets of information down to summary displays, while retaining 'decision making' capabilities. However, the success of the symbol would initially require a connection to be made by the presenter for the viewer - as this would be understandable for the use of any symbol employed to communicate information. For new viewers after the initial release period, understanding would be supported through the connections made with presenter dialog and presentation context. For example, the words "positive quarterly result" should relate to the form of the signifier.

In addition, the thesis entitled *Organic Information Design*, (Fry, B., 2000), also influenced the design outcome. Fry (2000), investigates structures supporting continually changing data and organisms (p. 49), as the influence for its display metaphor.

Other information displays (e.g., Ecological Interface Design (EID) suited to process control display), were also investigated to assist with providing ideas, however EID is largely based around 'constraints' rather than User-Centered Design (UCD).

Movement

The Stock Market, with behavioral similarities to a 'super organism', is comprised of many smaller stock movements that influences the overall larger market hierarchy through sectors and indices. As Fry (2000) points out with organic movement, "even plants have streaming motion known as cyclosis, allowing them to bend and reconfigure. Movement is important for how an organism is perceived-it's the most basic test an observer uses to determine whether it is alive." (Fry, B., 2000, p. 56). Furthermore, Fry (2000) also points out that "movement is one of the most expressive dimensions available," which is suited to expressing "change in a set of relationships within a composition." (p. 57). Through human evolution, movement is an important factor in attracting attention (Fry, B., 2000, p. 57). This supports the conceptual movement within the final design solution.

Existing solutions commonly use static market charts to display information. Within the *Traders Nation* example (see Fig. 19), the chart supports 'live' market movement, however, in some display situations details are difficult to view. In comparison, weather information displays that are much larger, provide greater presentation interaction. Similarly, the grid used within the design solution, supports larger interactions with charts while also illustrating 'replay' or 'live' market movement similar to the interface by Roberts (2004). This view could potentially show a 3D view, however, this precision view supports identification of 'patterns' within price movements, while also identifying price points, support, resistance, and moving day averaging.

As observed within the *Traders Nation* (see Fig. 19) model, callers would be interested in knowing what price points to watch for 'support', 'resistance,' and 'breakout' situations and the best areas to watch for movement. The viewer 'calls ins', also contribute to the sharing of knowledge and discussion on what changes to look for. Consequently, educational benefits to viewers watching the live daily show (market days) are also an effect of greater interaction.

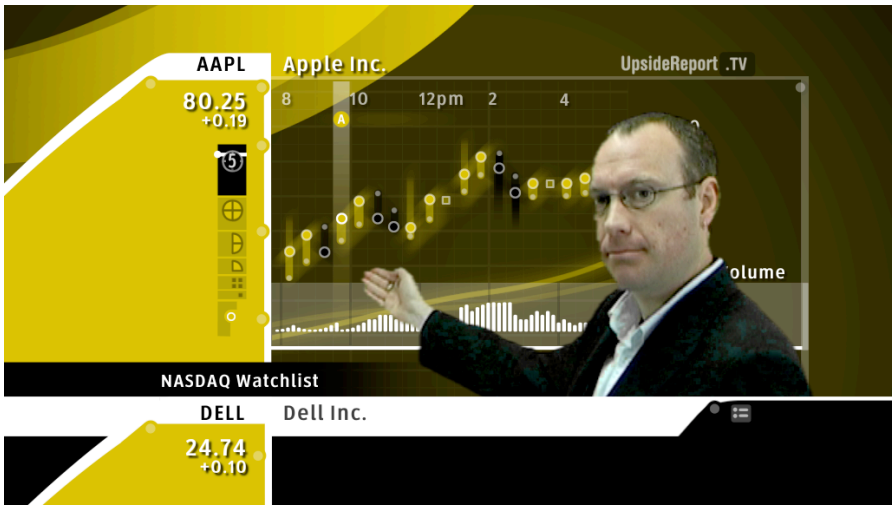


Fig. 36. Large scale interaction highlighting price movements.

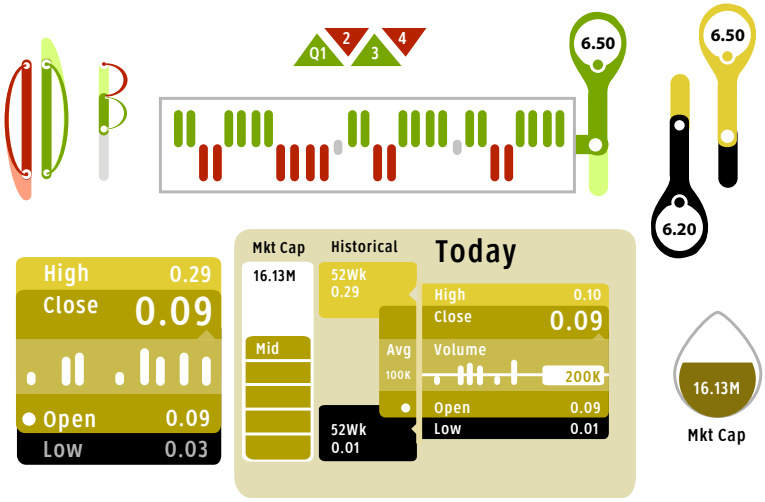


Fig. 37. Early explorations into information components.

Colour

Roberts (2004) discusses the colours and shapes used within his trading interface and questions the use of certain colours that have become a standard in representing change (p. 79) (e.g., green and red). Observations through the comparison study showed earlier within this research also support this point. However, some existing market reports (e.g., see Fig. 4, TV3) did show differences . In addition, other free to air channel reports (e.g., *Prime TV, NZ*) also showed differences. No evidence was found to support the use of these colours as an official 'standard'. This appears to be because of market graphics evolving over time.

Tufte (1990) discusses colour is a "natural quantifier" for values of information and suggests that colour sensitivity (p. 81), appropriate colour and placement context,

requires consideration within information design (p. 81). Tufte further suggests that colour should serve information (p. 82), while working with backgrounds (p. 90) and other elements (p. 92), while improving clarity and support for colour deficient people (p. 93).

According to available research on colour deficiency, "roughly 1 in 20 people" (*Vischeck*, 2006) - 1 in 10 men, are more likely to be effected (Wade, 2000). Research shows that shorter term trading is more popular with men[30]. This is significant, as market change is 'stereotypically' recorded with red and green symbols that rely on shape to signify market direction. The use of red and green, within designs requires the use of both shape, and change of values to improve display for viewing deficiencies related to the use of both these colours. Colour deficiency for the design solution - using *Vischeck* (2006), showed good results (e.g., contrast to differentiate). Colour deficiency may also be used as an advantage. As shown by military 'spotters' or 'snipers' are able to focus on small changes without distractions (Wade, 2000).

The tests supported the more common Deuteranope and Protanope (red/green) deficiencies, rather the than the 'rare' form of Tritanope (blue/yellow) deficiency. However, the interface design has only used this method for 'conceptual' testing and not through a colour deficient user group - this would be a suggestion for future exploration. Experimentation carried out with existing solutions shows what may be perceived if not supported by arrows to signify direction in this case.

Fig. 38. Original display

Fig. 39. Deuteranope display

Experimentation carried out with the proposed solution showing minimal difference between the original display (Fig. 38) and the other trials.

30 Although men make up the majority of market traders, women typically look to making better longer term investment decisions. See http://tacticalinvestor.com/womeninvestors.html

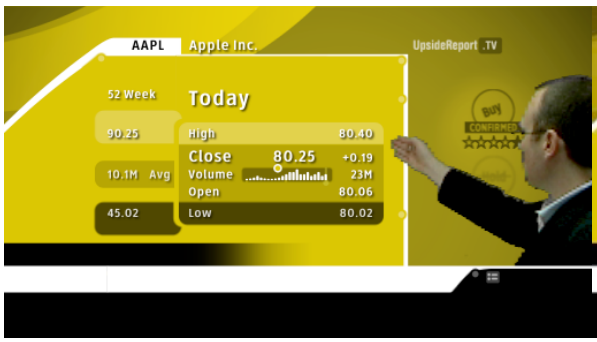


Fig. 40. Original display

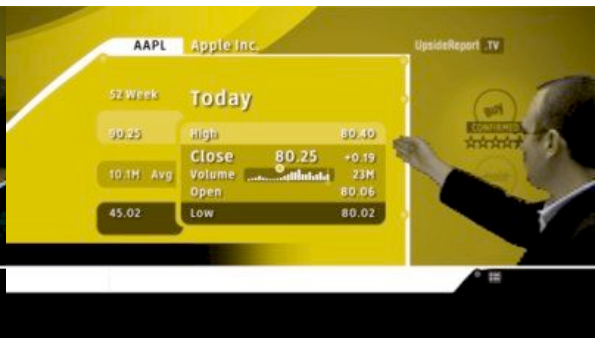


Fig. 41. Deuteranope (red/green)

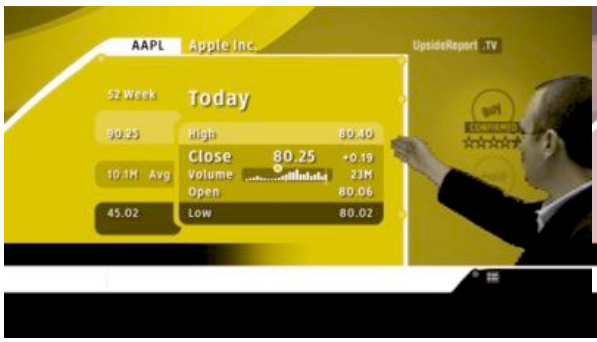


Fig. 42. Protanope (red/green)

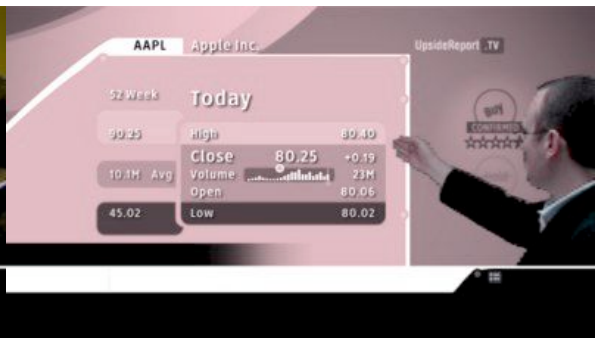


Fig. 43. Tritanope (blue/yellow)

Tests included Deuteranope (red/green deficiency), Protanope (another form of red/green deficiency), and Tritanope (blue/yellow deficiency), which is very rare (*Vischeck*, 2006). The most common suggestion for colour deficiency is to design for contrast variation. Figure 41-42, show minimal differences from the original display.

The use of monotone design assists the viewer in identifying change. Therefore, if the viewer can understand the logical use of colour within symbols, interface shapes, or ambient backgrounds, then information changes would support better focus. In addition, this would also support different 'levels' or abilities of viewers.

Initially, difference to other market broadcasts led to the change. With most business reports using blue as 'stability', the direction for the design was to embrace the change within the market and therefore 'yellow/gold' supports this with the chosen colour scheme. Peer discussion on what colours could signify market 'up' or 'down' that led to the use of yellow to signify 'up', and black for 'down' market movement - a play upon the light vs. shadow metaphor and the 'Chiaroscuro' painting style.

In addition, to the presentation of information, colour needs to be considered as part of channel branding considerations. For example, as Lloyd (2004) discussed colour used within BBC news and the departure from the use of blue, which led to its "much warmer and approachable feel" as part of the new branding (p. 30).

Salient Dynamic Qualities

Salient qualities explored within the design solution focused upon principal information hierarchies and relationships. This effects both graphic and typographic elements. Principal weighting also provides contrast between the primary and the secondary scrolling interface elements.

Use of colour within the interface change supports market direction with ambient information indicators for different screens. The more subtle use of transparent colour shows strength. Colour transparency supports information backgrounds while also improving viewing of text, video, or graphic elements. As Tufte (1990) pointed out, consideration for signal vs. background (p. 59) would promote more accurate data reading.

Highlighting within the design solution, shows events, notifications, and current selections. This is to show prominent turning points within the market direction.

Typography

'Information typography' within this research has focused upon screen based legibility issues. However, the intended solution could also be displayed on various screens and therefore influence typographic considerations.

For example, typographic considerations within broadcast design (Lloyd, P., 2004, p. 6) for the screen edge became an important part of the design limitations (Lloyd, P., 2004, p. 6).

Within the article entitled, *Design Issues for Dual Device Learning: interactive television and mobile phone* (Pemberton & Fallahkhair, 2005), discussion is given to typographic display constraints. Suggestions by Pemberton and Fallahkhair (2005) for the use of type within broadcast design, consider both viewing distance and legibility (e.g., Sans Serif fonts), with a minimum size set to 18 point (p. 5). However, as Pemberton and Fallahkhair (2005) point out, if the media containing typography is to be displayed on mobile screens, then because of the closer viewing distance, support for smaller fonts is possible; typically 5-6 point (p. 5). Similarly, with both devices, there are still limitations on displaying large amounts of information, hence, short 'chunking' of information as opposed to large amounts of text is better supported (Pemberton & Fallahkhair, 2005, p. 5).

Textual elements (kept to a minimum), assist the viewer with 'precision' as this is often a factor to 'overwhelming' the viewer. Textual elements within the design were compared to other types of information screens.

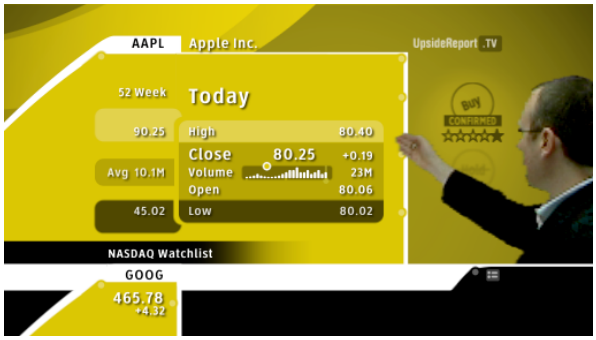


Fig. 44. Original display

Fig. 45. Sports Information

Information Typography comparison test with a sports screen[31].

5.2.6 Controllable Display and Selection

Research into controllable displays showed that larger presentation systems could potentially support interactive dialogue with audiences, and therefore provide more varied and engaging presentation scenarios when working with information sources. Mult-touch 'surface' displays using a NUI (Natural User Interface)[32], support environments that also provide opportunities for instructional and social interaction.

Multi-touch displays, also support minimised (or 'invisible') interface controls, with interface gestures. For example, a plinth based listing used within the design solution, may offer vertical dynamic scrolling through the gesture of the presenter's hand.

The combination of dynamic information and multi-touch presentation within financial news provides new potential, and innovation within reporting.

31 Sports information display from http://www.nztvpres.info/skynews/06au3.php

32 Microsoft Surface display from http://www.pcworld.com/article/id,132352-page,1/article.html

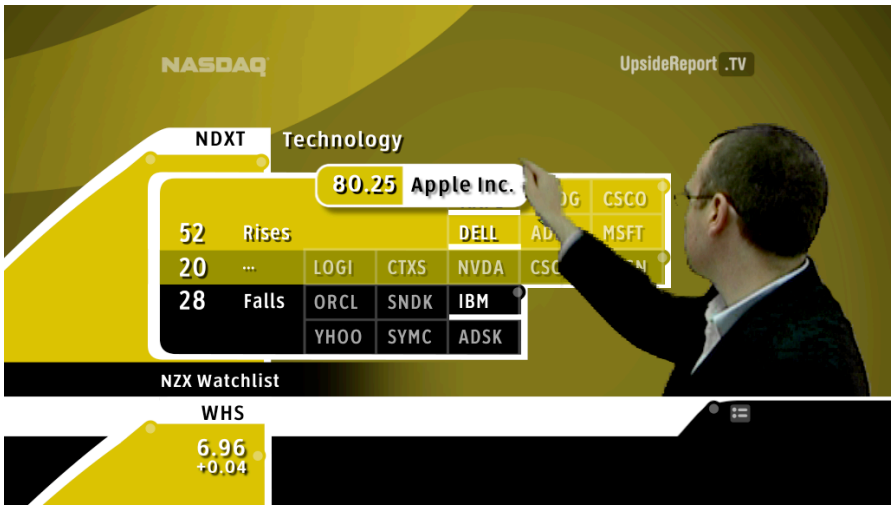


Fig. 46. Wider contextual view.

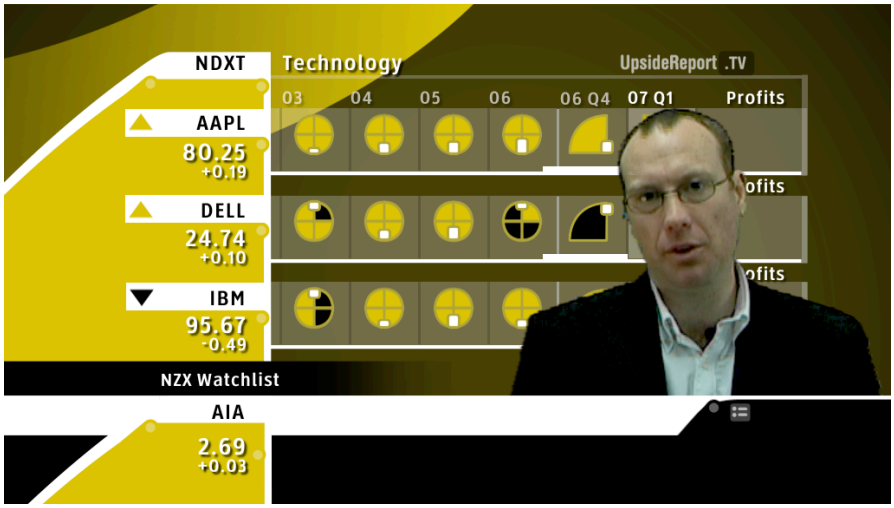


Fig. 47. Comparison view showing similar annual profit information.

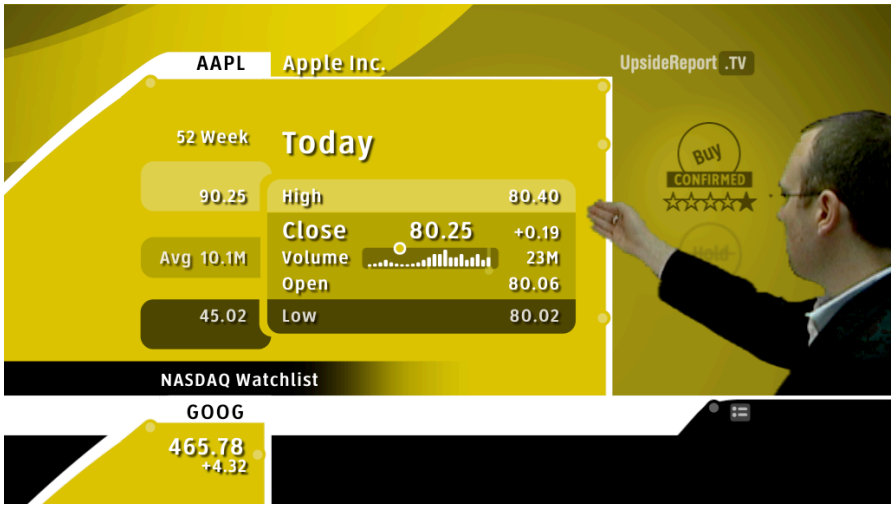


Fig. 48. Presenter assists with supportive gestures.

Content display is maximised, instead of using buttons and other interface elements - a large departure from other application interfaces. However, contextual button points, assist with display of control options. Hence, the additional suggestions for gestures (Fig. 49) - inspired by the Apple iPhone interactions and the Multi-Touch Interaction Research (2006) by Jeff Han and earlier multi-touch research by Bill Buxton. This illustrates the navigation techniques to control the interface. These would support the presenter, within the multi-touch 'virtual set'. In addition, offscreen navigation would also support the changing of display states. However, for the user who may not be viewing on this type of screen, would require support for mouse-driven interaction to control the personalised ticker area.

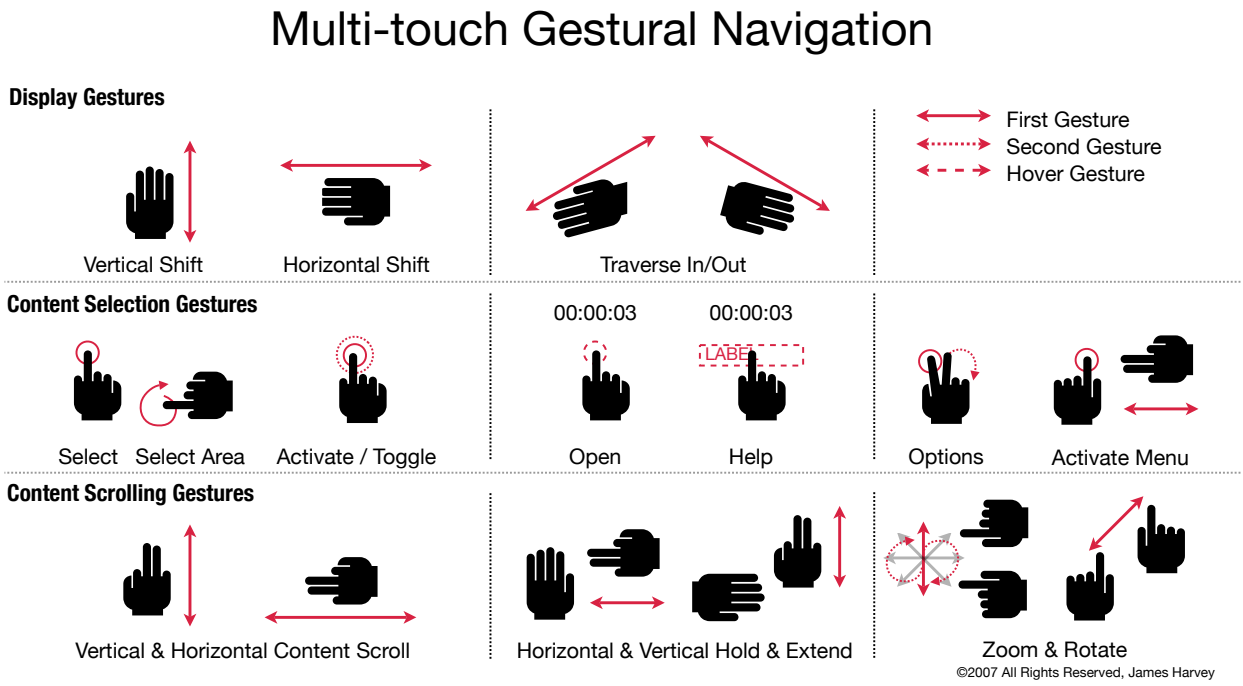


Fig. 49. Suggested multi-touch commands to support the design outcome for interface and content control interaction used by the presenter.

Variations for Representing Diverse Data-sets

Variation within information display was evaluated depending on the 'point' that is being made by the presenter. Different data-sets that have been aggregated together may support multiple views, or information sub sets. For this reason, the selection of views needs to be considered for the most common scenarios - as discussed by Koomey (2001). These views are chosen, depending on the needs of the 'story' being presented.

For this reason, the design direction needed to support variation and change. Earlier designs, were not as successful as additional views were needed to present the same information 'points'. The design solution provides greater flexibility with switching views and information. This is a significant departure from existing stereotypical market information presentation models.

Conceptual Views

The design exploration, largely governed through the ability to 'traverse' information in an 'organic' way, display both wider context, and narrower focus conceptual views.

Prototyping of design used image editing and presentation software. Withnell (2006) similarly suggests other prototyping tools to illustrate possible design solutions. Conceptual views were developed with presentation software, while video editing software was used to compose graphic and video elements together.

Both interactive and time based media provide additional meaning dimensions, while also supporting presentational differences. In addition, views would support typical information display sequences and provide the ability for alternative actions when required (e.g., viewer/audience interaction).

The main section within the controllable display would show the streaming presentation. The bottom part of the screen layout supports information based upon editorial selection and viewer preferences. The use of 'add-on' bookmark style linking or 'starting points', connects personalised Web information (e.g., watchlists, using contextual option displays).

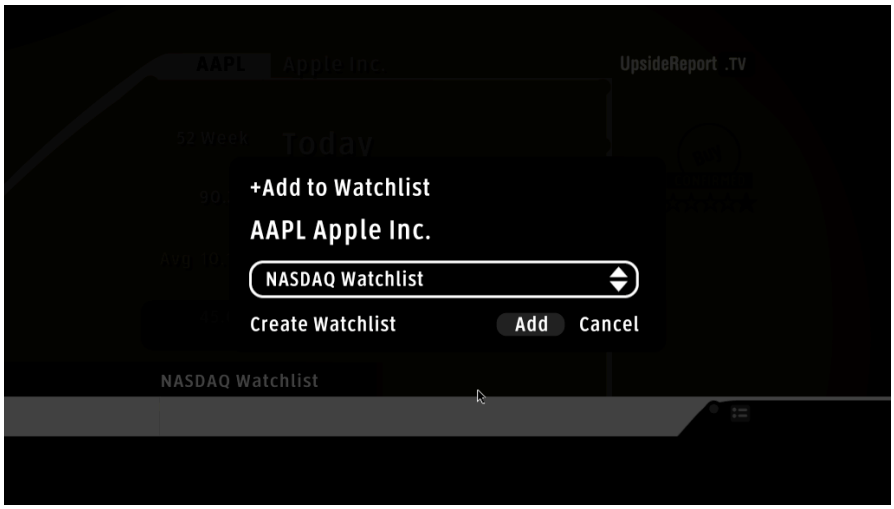


Fig. 50. Example of 'marking' information connected to website preferences.

This type of interactive 'overlay' would also support additional options (e.g., potential trading connectivity). Information would be sent through to the website and made available to the viewer upon logging in.

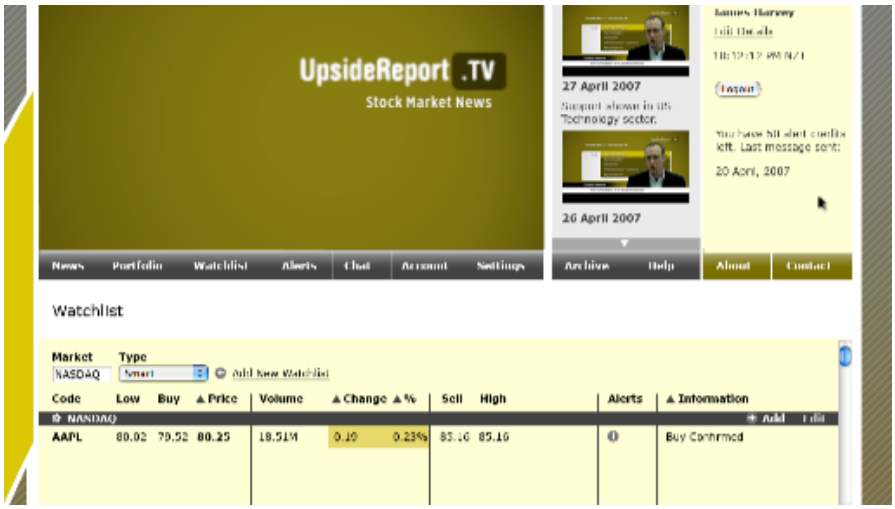


Fig. 51. Example of website (cropped display) with support for watchlists.

The website (Fig. 51) would also provide additional support information about the display. First, time investors would also be supported with market education through the use of visual information to support understanding.

Viewers can also contribute with their knowledge to provide additional benefits and interaction to support a more 'social' Internet TV solution.

5.3 3D Vs. 2D Information Display

The way in which information is displayed is often debated, however, clearly both static two and three dimensional displays provide different viewing experiences.

The work by Roberts (2004), is significant in the fact that it deals with the use of motion. The three dimensional model using motion 'replay' is a departure from the traditional format of static charting by allowing the user to understand the 'personality' of each stock and its daily price movement. Live data charting can support market motion, however, 'replay' actions similar to that used by Roberts (2004) have not been observed.

However, existing research compares the effectiveness of either display types. For example, within the paper entitled *Revisiting 2D vs 3D Implications on Spatial Memory* (Cockburn, A., 2004), study into spatial cognition, found that the "effectiveness of spacial memory is unaffected by the presence or absence of three dimensional perspective effects in monocular static displays." (Cockburn, A., 2004). Three dimensional perspective views may lead to distorted scaled and price patterns, conse-

quently making pattern recognition and evaluation techniques more difficult. This would also become an important when evaluating display types or providing 'mixed mode' transitional views.

Within weather presentations - both three dimensional and two dimensional views are used. Each mode evaluated for communication to support the segment overall. It is evident that both views require consideration when presenting information and therefore 'mixed mode,' or a multiple view approach could be explored further.

5.3.2 Branding and Identity Design Considerations

According to Lloyd (2004), design of broadcast channels is a way of providing identity. Design elements create a visual system for the display of content, consistent in look and feel even across multiple channels (Lloyd, P., 2004, p. 12). This is also suggestive of the 'feel' or nature of the channels programming.

Martin Lambie-Nairn, who designed identities for the BBC and Channel 4, UK, significantly contributed to the development of graphic design, and branding within television (Lloyd, P., 2004, p. 33). The use of branding became popular and graphic design played a "key role." Computer developments made available to the designer later on, lead the greatest change within broadcast design.

Lloyd (2004) points out that graphic design has been part of television and channel identity (e.g., indents and 'stings'), from its earliest experiments (p. 5). In addition, the introduction of digital editing systems (e.g., *Quantel Paintbox* - 1980's), led to more complex image montages and onscreen lettering (Lloyd, P., 2004, p. 7). Lloyd (2004), also points out that this also enabled the designer to quickly create screen information graphics, animated channel logos (p. 10-11) and window keys (i.e., the graphics shown behind the presenters showing an image for the current news item) (p. 29).

Within the design solution, the bull, and bear market figures are used within the opening title sequence to establish the colour theme associated with the display of information used within the presentation symbolise both sides of the market. These help the viewer establish the positive, and negative market positions needed, therefore acting as a key to the presentation of quantitative information used within.

6. Conclusions

As growth in information sources continues, the 'tools' we use within the media context, require evaluation to their effectiveness, or become 'obsolete'. New design solutions bridge the gaps between technology change and media change. The design of better information 'tools' may also influence us in other ways.

> *We shape our tools and afterwards our tools shape us. (Marshall McLuhan, 1997, p. 164)*

As technology and media change, so do the needs of the information 'tools'. Improved summary tools provide effective communication in a more efficient manner.

6.1 Findings

The following findings from this research include:

1. **Historical and Existing Background** – The reporting of financial information via news broadcasting has been relatively unchanged over time. Even with advances in data gathering, real time sourcing and enhanced graphical design capabilities. The presentation of today's media such as (TV One, TV3) still present only limited data points such as overall market index, stock price, and change. In contrast, information used to support weather representations and displays, have undergone substantial change (e.g., TV One and TV 3 'Fly by' simulations) engage the viewer through multiple views to improve 'mental modes' and promote understanding.

   The observations into existing channels (mostly freely available online), shows that a large amount of similarity between information displays exists within market reporting segments (refer to Fig. 14-21 and Table 1). As the growth in data and information continues, the role of design to also support improvements upon existing solutions is needed. The change in media has also meant that there is a need for innovative design to improve the presentation of market information.

2. **Contextual Information** – It was found that traditional modes of broadcast market displays, hold little 'value' with viewing audiences. It is also believed that 'clarity' can be achieved over shorter amounts of time through transitional de-

vices, contextual improvements, and information summaries. It has also been shown that relevancy can be established using appropriate methods (e.g., *CANSLIM*), can be used to support evaluation. Improvements in information relationships through design, can create 'tools' that support better decision making and evaluation. Support for better interaction with both the content and viewing audience is needed.

3. **Audience and Key Contributors** – Just as McLuhan had discussed the 'Trojan horse' metaphor, Information Design within video media provides a strategy for increased viewer awareness, understanding, and exposure. Innovation plays a huge role in driving economic growth and also to move society forward. However, further research into how the storytelling methods may influence behavioural aspects is needed. It is envisioned that by improving awareness, peoples decision making process would also improve. This may lead to a larger meta-conscious effect on the economy. Other key contributors supporting specific areas provided inspiration and valuable direction, to include; Tufte (1990), Koomey (2001), Roberts (2004), Saffer (2005), and Coates (2002).

4. **Media Reporting and Delivery** – The growth in internet based media reporting and delivery models will continue to affect traditional channels. The 'Long Tail' economic trend supporting 'niche' content channels will continue to dominate, as media becomes more democratised. Emerging technologies and social feedback are supporting innovation within reporting. With the growth in information sources, reporting trend based information has become more prevalent through the use of data-mining techniques to display trend based information. It is envisioned that this type of design may also display other trend based information (e.g., currency, commodities, options, weather derivatives, climate change information etc.).

5. **Design Principles** – Using a broadcast aesthetic to create interesting graphics requires suitable balancing through the use of information display principles. Principles by Tufte (1990) - applied to the design solution, improved 'clarity' and understanding within conceptual testing. Evaluation of existing stereotypical displays, contributed towards establishing differences with the design solution. Design management methods by Coates (2002), became a key factor in supporting new ideas for the design of the presentation interface. In addition, better information relationships and connections improve 'clarity' or support better deci-

sion making. However, the complexity of the design to support better decisions is also largely in-proportion to the complexity of the information.

6. **Design Evaluation** – The use of organic forms with 'seamless' connections assisted with retaining visual connections between information screens. It is also through the composition of information, motion graphics and other design elements that communication can be enhanced. In addition, existing 'mental models' could support further design iteration with fresh insight. Design 'value' can improve existing data sources, while using suitable market evaluation methods (e.g., *CANSLIM*). This may also effect positive economic and possibly social change if adopted on a large scale by viewers, enabling them to 're-skill' themselves by adopting a more in-depth view of market information.

7. **Prototype** – It was determined through the use of a peer review process that the conceptual design prototype would require further exploration to test AI based 'filters' and aggregation techniques further.

- The size of the peer review group was limited to 10 participants. The use of a larger group would be more appropriate for further working prototypes.
- Reaction to the display was positive with appropriate connections. However, overall controllable display behaviour is inconclusive needing full working model (see recommendations).
- Hierarchy was shown to be logical for critical information.
- Typography could support scaling well, however some issues with text upon lighter backgrounds may exist when displayed on some screens.
- The use of colour showed positive reaction with testing overall with few minor reactions to 'stereotypical' green/red change.
- Overall balance between consolidated graphical variables and precise text information, provided an efficient use of screen real estate.
- Potential for better decision making was shown, however further study is needed.

8. **Testing & Evaluation** – Those who have basic or no very little market knowledge, evaluation showed that understanding was improved. It is believed that a full working model would also support further positive results within future work.

6.2 Recommendations

As a result of this research, the following recommendations have been made:

1. **Test for Simplification** – For the viewer to understand more complex ideas, it is not just a case of simplification. Simplification of information leads to the creation of non contextual trivial facts. The evaluation of the information 'points' is an important part of understanding information relationships viewers have, therefore simplification within the design process needs to consider the effect of loosing potential information that may assist with understanding or decision making.

2. **Managing Complexity** – Information density and complexity can be managed with an adjustable layout supporting time series information. Therefore, the complexity of information cannot be easily controlled, but managed more effectively through design by 'progressive disclosure' with less disruption.

3. **Value** – The display of graphics to support market stories should be evaluated for how the information could be used by viewers, rather than presenting just 'superficial' facts. Information 'value' is largely dependent on the delivery model and design of information variables to support appropriate viewer evaluation methods.

4. **Summary Displays** – By improving viewer understanding through design of summary displays, better evaluations within shorter time frames could be potentially achieved. Although, the mix of quantitative information, footage, and presenter dialogue need further study, it can be predicted that better overviews of information, supported by storytelling techniques will improve entropy.

6.2.1 Future Work

Suggestions for future work include:

1. **Fact vs. Information** - Further work requires testing the hypothesis against the perceived problem of 'facts vs. information' and evaluated against existing stereotypical displays.

2. **Reactive 'Tensions'** – Future models may also look at the use of reactive information interaction elements that may show better 'cause and effect' style

relationships. This also supports further investigation into 'tensions', to illustrate interactions of different elements within stories.

3. **Multi-touch Presentation Displays** – Multi-touch displays that support large scale interaction with 'virtual sets' suited to studio lighting conditions are required for a full working model.

4. **Market Education** – Information Design is also needed to support a better understanding of overall process within the Stock Market, relationships and terminology. This is one of the most significant barriers to viewers understanding and needs further exploration to support 'first time' investors. This might also investigate financial related topics within media and the effect it has on investor understanding.

6.3 Final Comment

The mixing of information, news, and entertainment, (and all three together), will provide new genres for designers to explore. Media convergence between broadcast and the web continues to change the aesthetic to being more 'hybridised' over time. Media and device convergence taking advantage of richer streaming solutions, will enable a greater amount customised user information and feedback to enhance ubiquitous viewing experiences (e.g., Mobile TV and Internet TV devices). Such ubiquitous viewing experiences may support interconnected devices. Therefore, design must also take into consideration the delivery platforms (e.g., Sling Media's *Slingbox*, Vara Software *Wirecast*) for content creators to broadcast, narrowcast or even personalcast information to viewers to create Info-TV anywhere situations.

In addition, smarter semantic search capabilities for media will evolve to support better personal information agents and AI systems[33] for news and information reporting. Web based editorial agents will also mean that relevant information can be broadcast to viewers, while also supporting different audience feedback methods.

Information Design plays an essential role in creating value from data resources while improving the contextual relationships and display of information. For designers working with Information Design for IP broadcast media, this will mean creating value by turning data - now an accessible commodity, into meaningful information in an

33 Refer to Fig. 57 & 58. Beyond Web 2.0 and towards Web 3.0 & Web 4.0.

efficient manner. Information Design solutions combined with dynamic video information IP services, live data sources, and social interaction will continue to be a strategic part in providing information that improves clarity, viewer understanding and decision making experiences.

7. Glossary

Bull market (Similarly Bull and Bullish)

A market in which share prices are rising, encouraging buying.

Bear market (Similarly Bear and Bearish)

A market in which prices are falling, encouraging selling.

Broker & Brokerage

*A **broker** is person who buys and sells stock on behalf of others. A **brokerage** is a company that buys or sells stock for clients through commission or fees.*

Candlestick

*A graphic symbol that records Open, High, Low, Close information. The colour of the candle reflects the overall price movement within the period assigned to the candle. Used within **candlestick** charting.*

Investor

A person who has the expectation of achieving a profit over a longer time frame.

Playout

Broadcast services that support transmission of content to viewers and incorporates live studios, graphics, video, audio.

Resistance

The price at which a stock or market has trouble exceeding, for a certain period of time.

Support

The price level which, historically, a stock has had difficulty falling below.

Terrestrial

Television broadcast using equipment situated on the ground rather than by satellite: terrestrial and cable technology.

Trader

A person who buys and sells stocks (may also trade commodities, currency) over a shorter time period than longer term investors.

8. Appendix

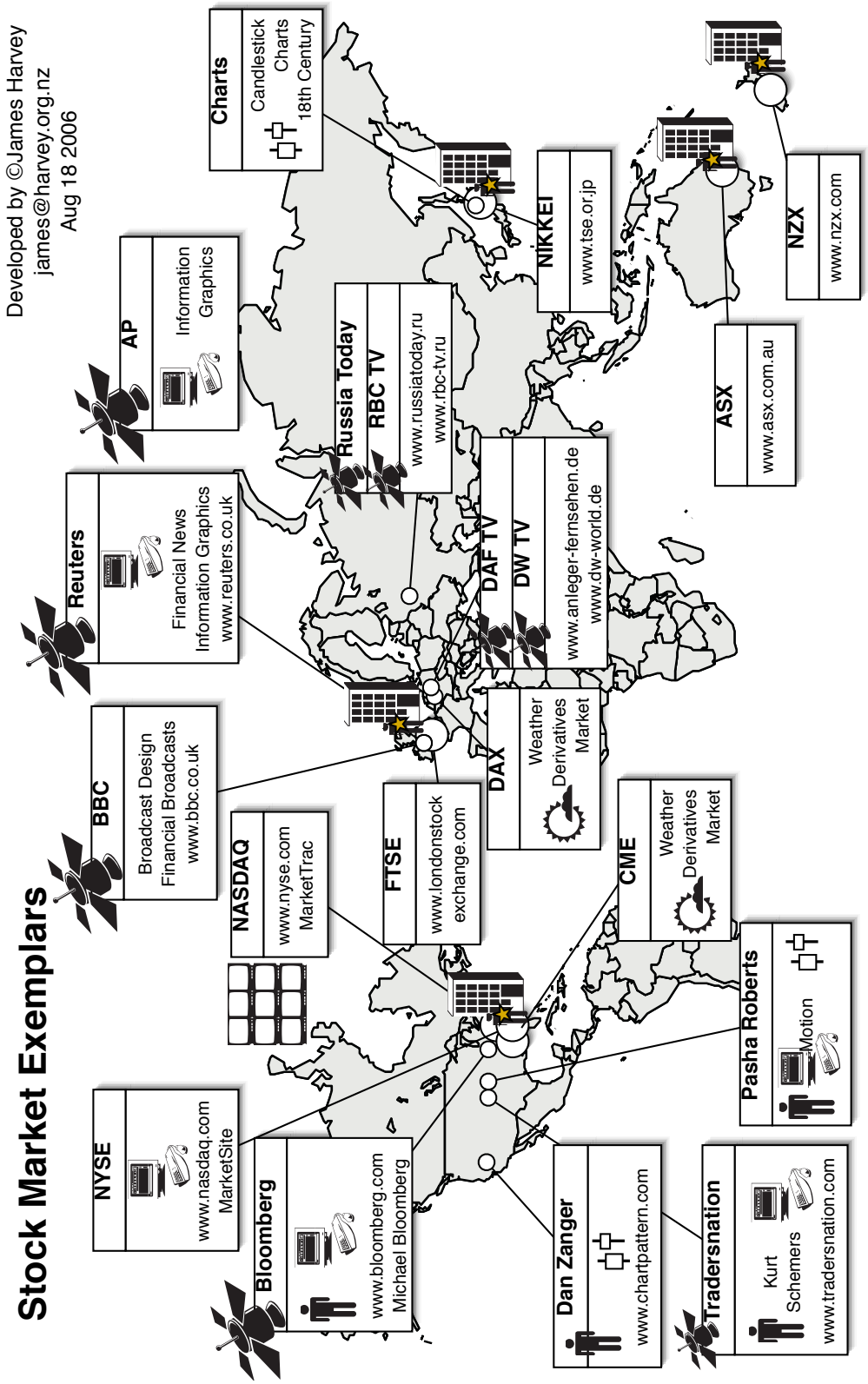


Fig. 55. Relevant examples looked at within this research.

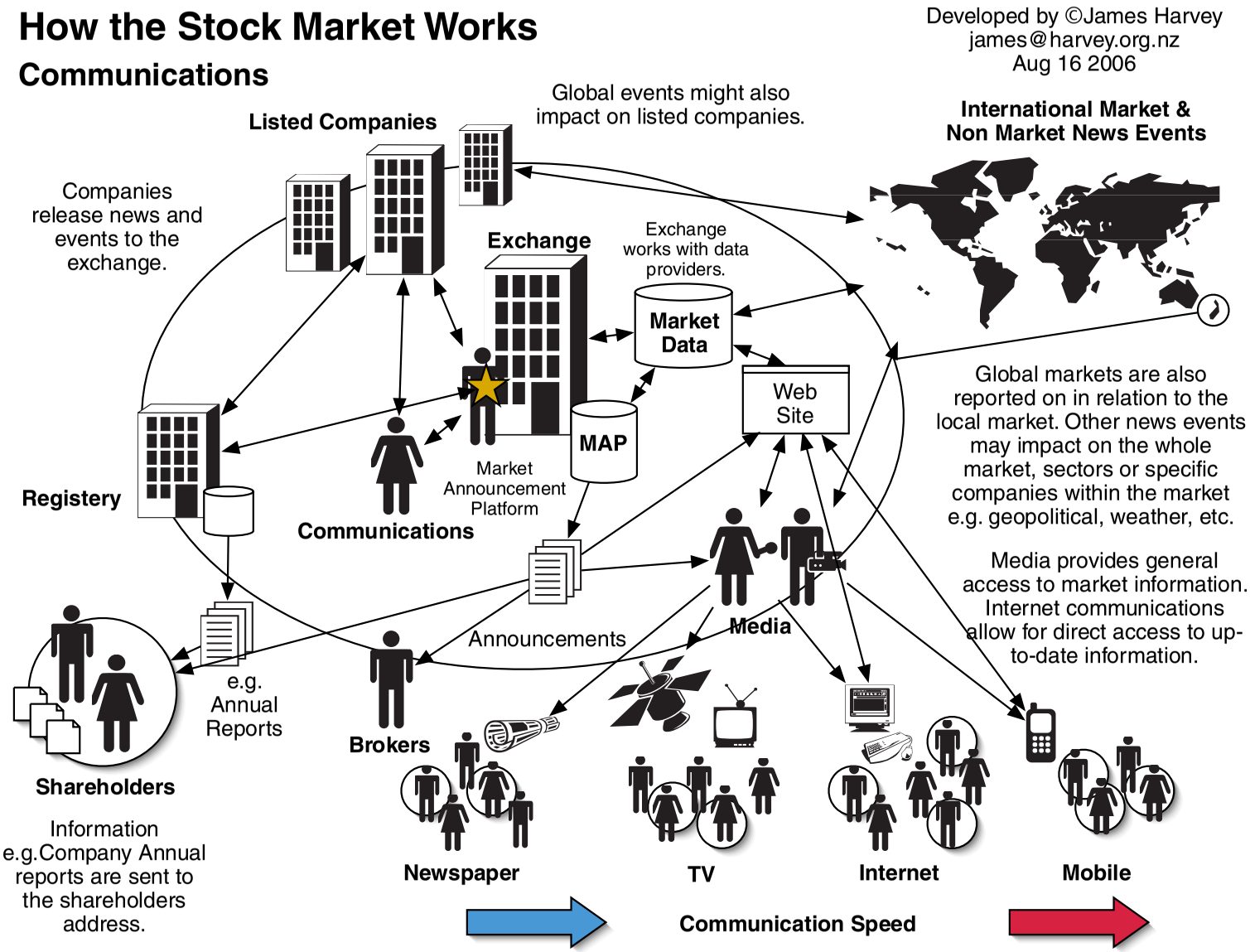
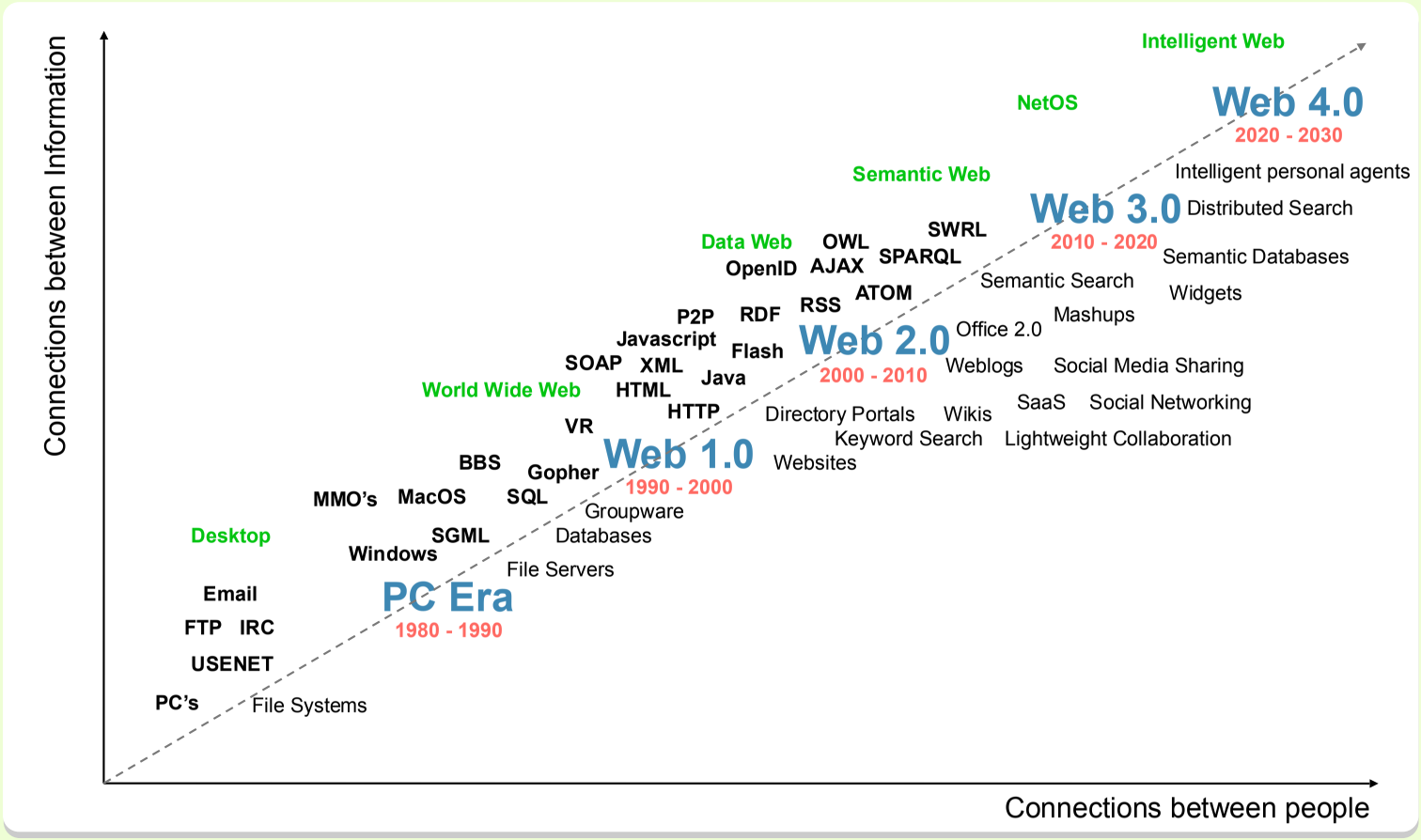


Fig. 56. Market media and information relationships

The Semantic Web – Everything Is Connected



 Source: Radar Networks & Nova Spivack, 2007 – www.radarnetworks.com

Fig. 57. Sourced from http://lifeboat.com/ex/web.3.0

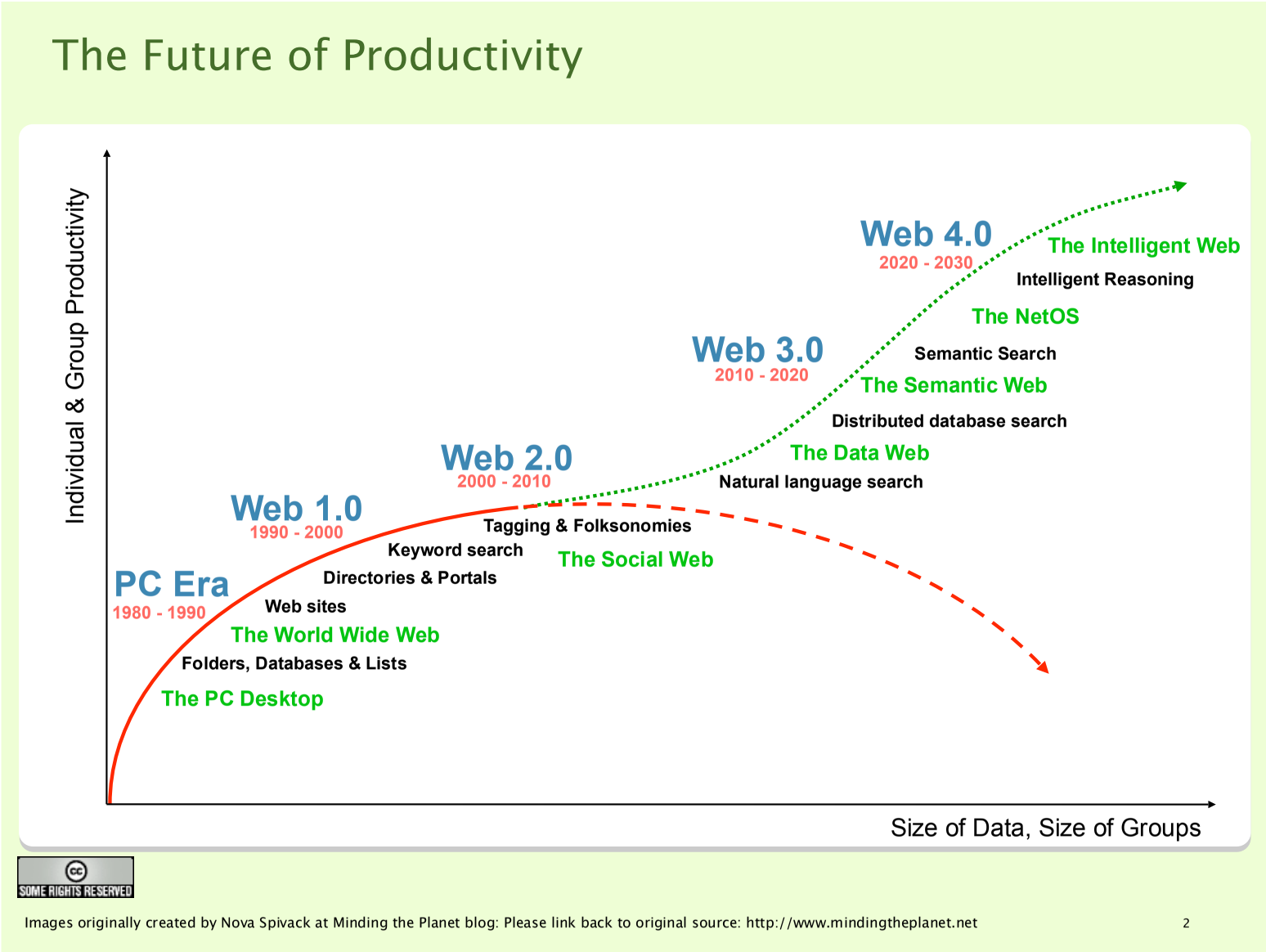


Fig. 58. Sourced from http://novaspivack.typepad.com/nova_spivacks_weblog/2007/03/beyond_keyword_.html

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