

Harvey 2007

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

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1. Introduction

Interaction Design, which is essentially story-creating and telling, is at once both an 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 Design¹ 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

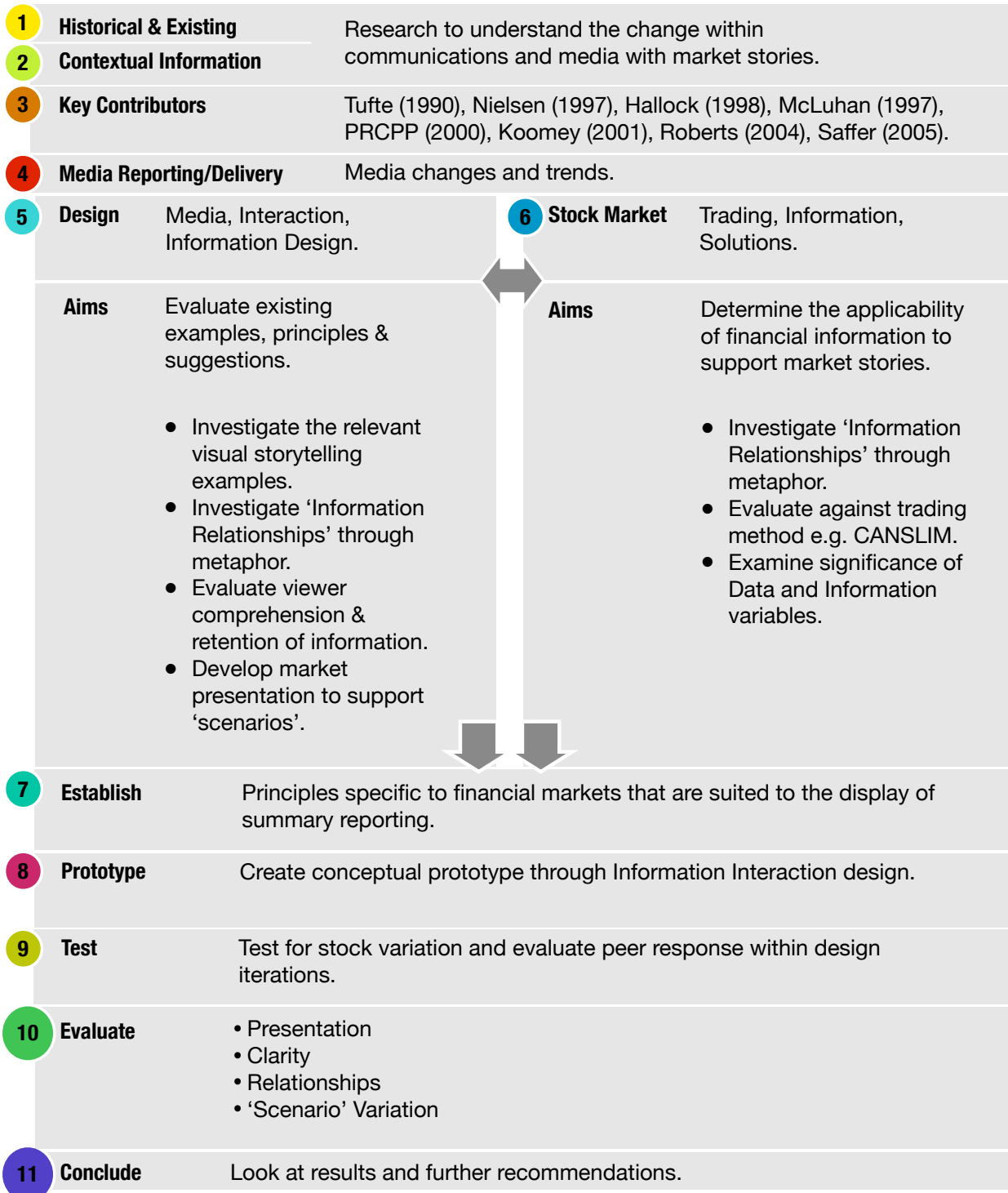


Fig. 1. Shows research process and other relevant points for discussion.

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.

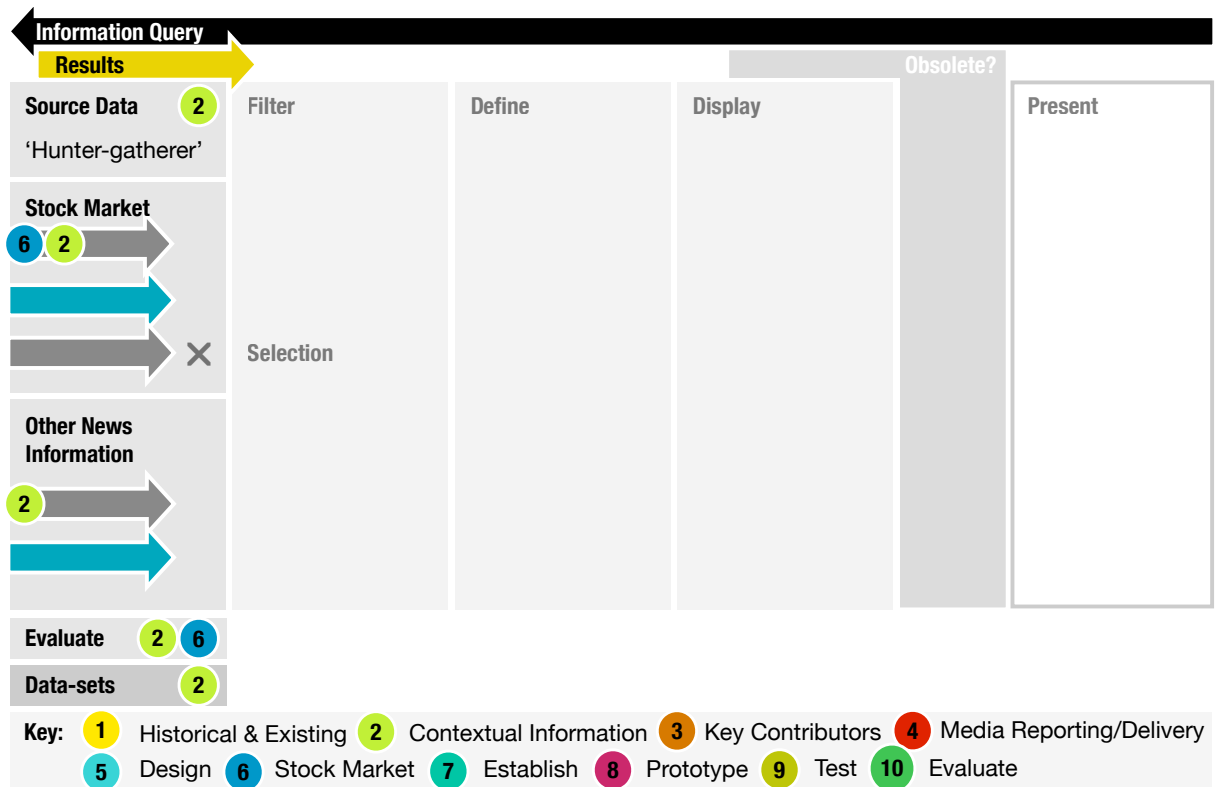


Fig. 2. Agent query is made to various data sources⁴.

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 through 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.

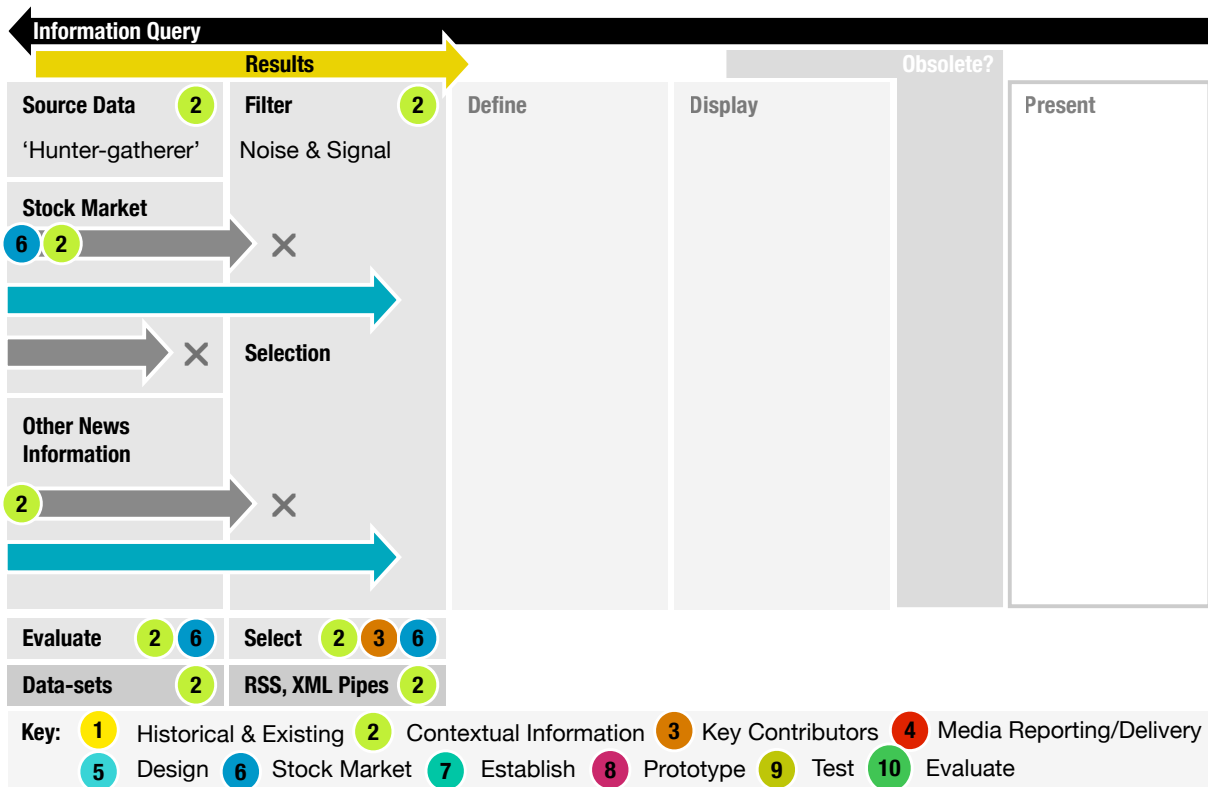


Fig. 4. Filtering and selection of data.

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)

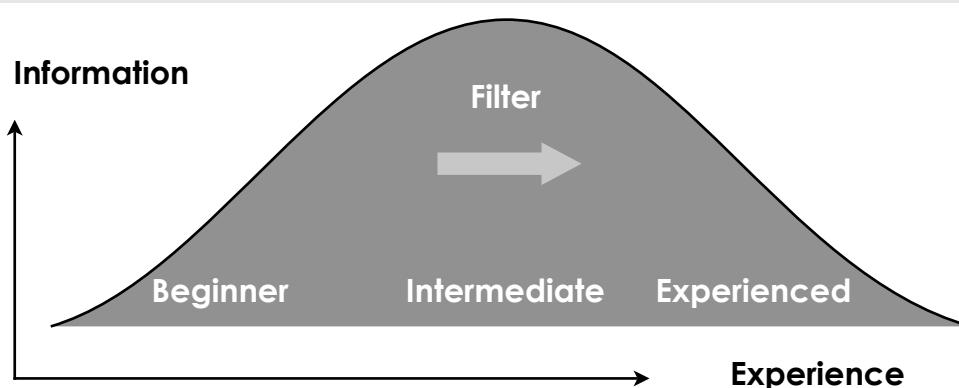


Fig. 3. The beginner is quickly overwhelmed by inefficient filtering of information. As experience is gained filtering becomes more effective.

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 interest⁹.

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 on-line trading before the 'dot com' NASDAQ crash in March 2000¹⁰. 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*TM, Smartmoney *Marketmap*TM) 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; eXtensible 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.

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.

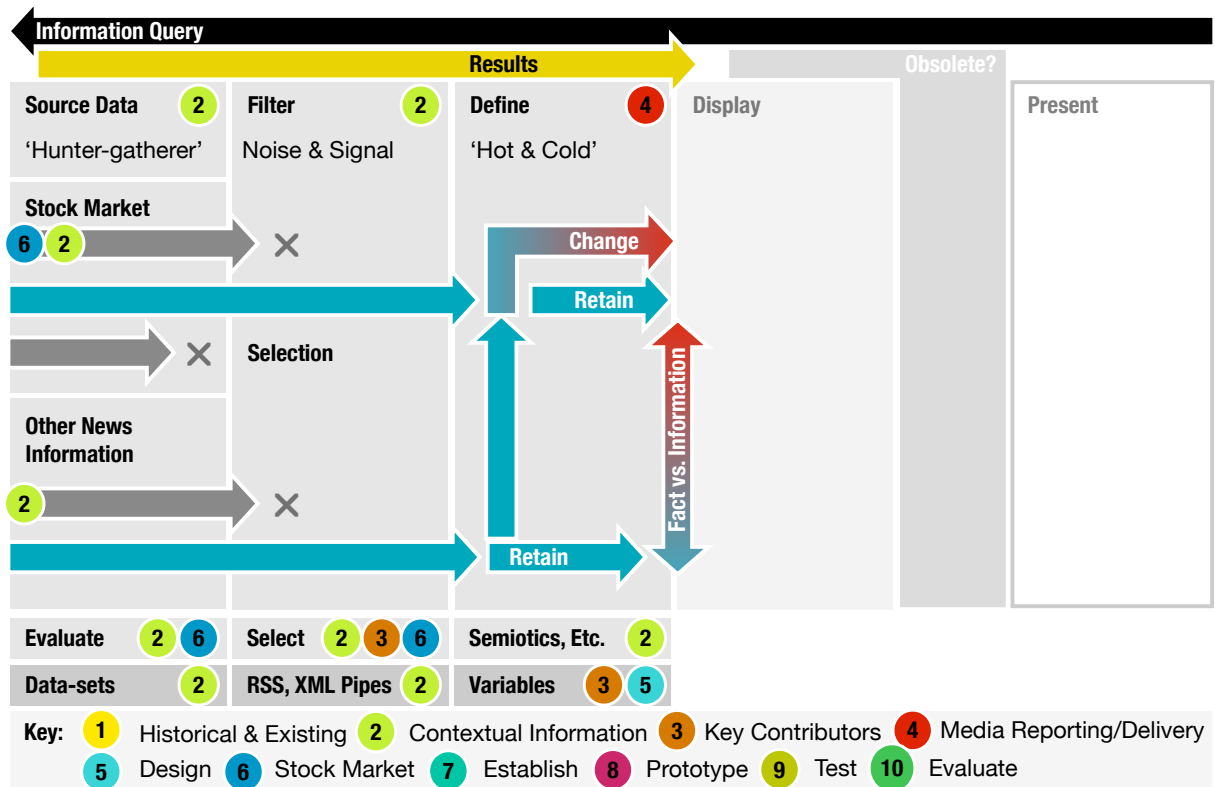


Fig. 5. Redefined data - enhanced for communication.

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 led 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 affecting 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 transformed¹¹ 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’.

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.