THE COMBINED CONCEPTUAL LIFE CYCLE MODEL OF INFORMATION QUALITY IN USER PERCEPTIONS OF IQ ON THE WEB

(Research Paper)

Shirlee-ann Knight
Edith Cowan University
s.knight@ecu.edu.au

Abstract: Presented is the Combined Conceptual Life Cycle (CCLC) Model of Information Quality (IQ). The CCLC conceptualises information/data quality as being a highly relative construct, best understood in terms of sixteen IQ dimensions housed within four broad IQ categories: namely; Intrinsic IQ, Representational IQ, Interactional IQ, and Contextual IQ. The four categories themselves are seen as falling into two information life cycle contexts: that of (1) data/information generation and (2) data/information use. By conceptualising user perceptions of IQ in terms of the information life cycle, the model is able to demonstrate where in the information life cycle users are most likely to engage specific perceptions of IQ, and predict the relative impact those perception might have on the user‟s general perception of IQ. In this way, the model begins to illustrate how users perceptions are able to legitimately vary depending on individual differences between users and information contexts.

Key Words: Information Quality; User Perceptions; Information Retrieval; CCLC; Combined Conceptual Life Cycle Model of IQ;

INTRODUCTION:

This paper presents and discusses the Combined Conceptual Life cycle (CCLC) model of IQ (see also [34]) which was developed as part of a research project examining user perceptions of IQ in the context of their World Wide Web information retrieval behaviour. As an information environment devoid of enforceable IQ standards [24, 8; 31] the Web provides an extraordinary observational context where users are often required to determine IQ for themselves.

Presented first is the theoretical underpinnings of the model, which outlines how the CCLC is able to conceptualise commonly accepted user perceptions of various IQ dimensions as part of an information life cycle of information production (also generation) and application (also retrieval and/or use). The methodology of how the dimensions for the CCLC were empirically selected and tested is then presented, followed by a discussion of some of the preliminary findings of the first empirical testing of the model.

DEFINING INFORMATION QUALITY:

The "Fit-for-Use/Purpose" Paradigm

Information Quality (IQ) has been described in the literature as a complex, multi-dimensional construct [3, 29, 1, 39, 22] in that multiple factors determine its perceived status and application. A somewhat general consensus has been reached in relation to a definition for IQ as being information/data that is "fit-for-use" (also "fit-for purpose") [74].

The "fit-for-use/purpose" paradigm is useful in that it implies IQ is *context* driven [38, 22, 18, 48, 61]. The value of seeing IQ as context driven construct is that it:

1. Enables researchers to conceptualise the processes involved in any user/information interaction processes (*for examples see*: [74, 60, 14, 16, 26, 17, 46]);
2. Facilitates the process of associating characteristics (most often called IQ "dimensions") with the information, which can be used as IQ value-judgment criteria (*for examples, see*: [26, 51, 10]);

3. Helps researchers to better understand what criteria users may employ in their value-judgements of information (*for examples see*: [11, 41, 32])

The "fit-for-use" concept has been widely embraced for several reasons. Firstly, it conceptualises into simple language a complex notion associated with multiple user/information interactions, contexts and value-judgements, while still remaining enigmatic and relative like the concept it is used to define. Secondly, it facilitates the idea that quality in information is relative, that is; information considered appropriate for one use – and therefore perceived to be of high quality – may not possess sufficient attributes for another use [67]. Thirdly, it gives IQ an investigative context in that it implies IQ cannot be defined and assessed outside of the reason for which it exists [63, 64]. This is important, since it provides clues for where researchers might begin looking for examples of IQ.

Perceptions of IQ in User/Information Behaviour

The problem with defining IQ in such non-specific terms as "fit-for-use" is that researchers are still no closer to actually defining what a „quality" piece of information is, or what criteria can be used to quantify or measure it. Instead, "fit-for-use" recognises the context of information, that is; that which is considered a „quality" piece of information is highly reliant on the perceptions of users interacting with that information [55, 30, 13, 71, 20, 73, 32]. In other words, the quality of information cannot be assessed independent of the people who will use that information, which – as it turns out – is what makes this concept of IQ ultimately so useful, since it implies that *users' perceptions of IQ will be manifest in their information behaviours*.

It is these two presuppositions: (1) that IQ is highly contextual; and (2) that perceptions of IQ can be observed (and therefore measured) in users information behaviours; which have theoretically driven the development of the many frameworks designed to conceptualise and measure IQ since Wang, Strong and Lee"s groundbreaking "fit-for-use" papers [74, 63, 64]. The CCLC too, is based on these two assumptions, and was developed from a synthesis of twenty IQ frameworks and models published over the decade from 1996-2006. The twenty IQ models and frameworks used to construct the specific IQ dimensions associated with the CCLC are presented and summarised in Appendix 1.

Information Quality as a subset of testable IQ Dimensions

The frameworks cited in Appendix 1 can be classified into four broad types of IQ models.

1. *Conceptual IQ identification models:*
   inc: CIQF - Categorical Information Quality Framework [74]; Extended ISO Model [77]; SDQF - Semiotic Data Quality Framework [60]; Conceptual Framework for measuring IS Quality [14]; Mapping IQ into the PSP/IQ (becomes AIMQ) [26]; IQM - Information Quality Measurement Methodology [17]; IQ as an evolving Life Cycle [42].
2. Frameworks that push *existing models in order to apply them to a Web environment*:
   inc: Extension of IQF into Web environments information contexts [27]; Detection of IQ problems by users on the WWW [30]; Synthesis of IQ and TAM models to conceptualise user value judgements during info retrieval of Web-based health information [61].
3. Development of *IQ conceptual models into machine readable metrics*:
   inc: Quality metrics for information retrieval on the WWW [78]; Classification of IQ Metadata Criteria [47]; Using IPMAP to create machine readable (quality related) metadata about data [58]; Quality metrics used to create Wikipedia IQ evaluation tool [66].
4. Practical application of *IQ guidelines* to build user-resources and *"how to.." frameworks* for searchers of information – specifically user/searchers on the World Wide Web.
   inc: CARS Checklist for Information Quality [23]; (Web) Evaluation Criteria [6]; Web Wisdom [2].

While varied in their approach and application, Appendix 1 clearly illustrates that the twenty frameworks share numerous common characteristics regarding their classifications and descriptions of the dimensions of IQ. For example, the dimension/characteristic of *reliability* – closely associated in the models with such constructs as authority, reputation and credibility – is present in seventeen of the twenty models. Likewise, *accuracy* (also „free-of-error" and „correctness") appears sixteen times, as does *currency* (also „up-to-date" and „timely"). Other constructs, such as relevancy, accessibility, usability (in terms of navigation and interaction), consistency, completeness, scope and objectivity appear in at least half the twenty frameworks.

Table 1. Sixteen Common Dimensions of IQ/DQ

	Dimension	# of times	Definitions & Relating Dimensions
1	**Reliability** *(also authority, reputation, credibility, dependable)*	17	The degree to which information is worthy of being depended on. Is built from other dimensions relating to authority, authorship and reputation.
2	**Accuracy** *(also accurate, correct, no errors)*	16	The degree to which information is correct, or free from error
3	**Timeliness/Currency** *(also up-to-date, timely, recency)*	16	The degree to which information is up-to-date, relative to the task at hand
4	**Relevancy** *(also relevant, useful, helpful)*	13	The degree to which information is applicable and helpful for the task at hand. Includes other dimensions such as useful.
5	**Accessibility/ Availability**	12	The degree to which information is easily retrievable by information seekers. Refers to both a physical access (i.e. through a network or internet) and cognitive access (i.e. easily read).
6	**Usability** *(also ease of nav., manipulation, interaction, user friendly)*	11	The degree to which information is can be easily found (i.e. navigated) and easily used.
7	**Consistency** *(also consistent, stability)*	11	The degree to which information is presented in an orderly, logical format that is compatible with other information contained within the same place
8	**Completeness** *(also complete)*	11	The degree to which all the necessary parts or elements of the required information are present.
9	**Scope/Depth** *(also coverage, amount of..)*	10	The degree to which the amount of information available from a source has the appropriate amount (or coverage) of information required.
10	**Objectivity** *(also free/aware of bias)*	10	The degree to which information is aware of (i.e. stated), or free from bias.
11	**Understandability** *(also interpretability)*	10	the degree to which information is capable of being understood or interpreted.
12	**Security**	10	The degree to which information is considered safe because of appropriate restricted access
13	**Value-Added** *(also uniqueness)*	9	The degree to which information delivers benefit by providing unique or distinct material.
14	**Concise(ness)**	6	The degree to which information is expressed in a compact, easy to understand manner.
15	**Believability** *(also believable)*	5	The degree to which information is regarded as true or credible, and therefore capable of being believed.
16	**Efficiency**	5	The degree to which information is able to quickly meet the 'information needs' of a searcher.

Table 1 lists the sixteen most common occurring dimensions and how often they appear in the twenty frameworks engaged in the original study (*see* [31]) associated with this research. It should be noted that a degree of conceptual analysis was required on the part of the researcher when determining the sixteen most common occurring dimensions listed in table 1. For example, what one author might call „right amount of information" [74, 30] another author might call „appropriate coverage" [6], while yet another author might conceptualise this as „information scope" [65]. In addition to using different words to conceptualise the same construct, authors may also use the same words to conceptualise different constructs. For example; Sturges & Griffin [65] conceptualise „appropriate for audience" as a *scope* construct, while Liu & Chi [42] conceptualise it in terms of *relevancy*.

Careful conceptual analysis of the frameworks in the literature arrived at the sixteen IQ dimensions listed in table 1 which were then categorised into four broad types of IQ, namely: Intrinsic IQ; Representational IQ; Interactional IQ; and Contextual IQ. This makes the CCLC structurally most similar to Wang & Strong"s [74] *Categorical Information Quality Framework* (CIQF), although there are some important differences. In addition to the 16 dimensions being chosen from a synthesis of the literature, rather than an adaptation of Wang & Strong [74], the process of grouping the IQ dimensions into the four areas was governed by contextual analysis of user-information interaction within an information life cycle, rather than conceptual analysis of IQ characteristics.

Conceptualising information characteristics according to the information"s context is employed by numerous authors. Shanks & Corbitt [60] contend that IQ should be assessed within the context of its generation, while Katerattanakul & Siau [27] advocate that it needs to be assessed according to its intended use. The reason this contextual approach is in line with Wang & Strong"s [74] fit-for-use/purpose paradigm, is because it recognises the attributes and dimensions used to assess IQ can vary depending on the context in which the data is created or to be used [58].

Information Generation vs. Application – IQ as a Life Cycle

Liu & Chi [42] conceptualised IQ in terms of the information life cycle. The concept of information interaction and use as a life cycle was not new to IS research (*see* [68, 25]), but its application to understanding information or data quality was. Liu & Chi developed their Evolutional Data Quality pyramid (figure 1a) which contented that the physical/actual characteristics of data quality fell into four „types" of quality which then built on one another in an evolutionary process. This type of approach meant that IQ could be conceptualised as a non-static construct which might vary through stages of the information life cycle (figure 1b).

Figure 1. Liu & Chi's Evolutional Data Quality model (2002)

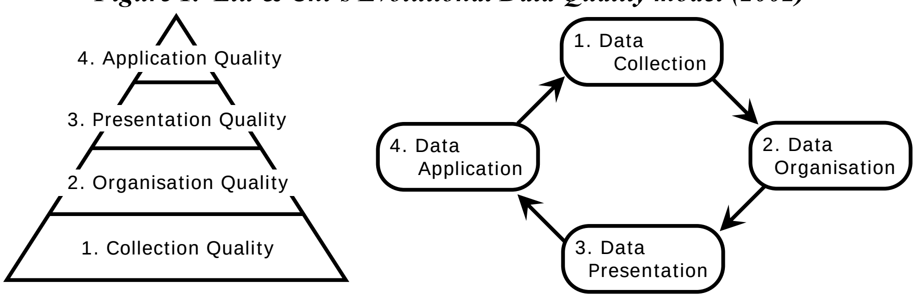


Fig 1a: Evolutional Data Quality *Fig 1b: Data Evolution Life Cycle*

Conceptualising IQ/DQ into four evolutionary stages of the information life cycle also allows for a more explicit separation of IQ into two over-arching contexts. That of: (1) information generation; and (2) information use. The CCLC sought to separate these contexts, since the framework recognises that user IQ perceptions are so contextually driven, that how a user might perceive a specific IQ dimension such as „information security" or „information access" could vary significantly dependant on whether that user was providing or retrieving information. So, while the CCLC model of IQ sought to synthesis the previous models in order to determine a robust sub-set of IQ dimensions, the overall framework became conceptually driven by the notion of the context-specific user/information „actions" or tasks [43] which typically take place within the various stages of information life cycle.

User/Information Interaction in the Information Life Cycle

From the large sample of human information behaviour literature engaged[1] four broad information actions/ asks were conceptualised as part of the user/information interactions which typically take place during the information life cycle. These included:

1. Information classification [50, 4, 5, 76];
2. Information production [59, 36, 57];
3. Information retrieval [62, 19]; and
4. Information extraction [21, 70].

It is important to note that the terminologies constructed here are not meant to be exhaustive, but are broad and encompassing descriptors of information actions which take place during the information life cycle. The positioning of these descriptors into the information life cycle helps the researcher to identify the types of potential information demands and related IQ value judgements users might make of the data they

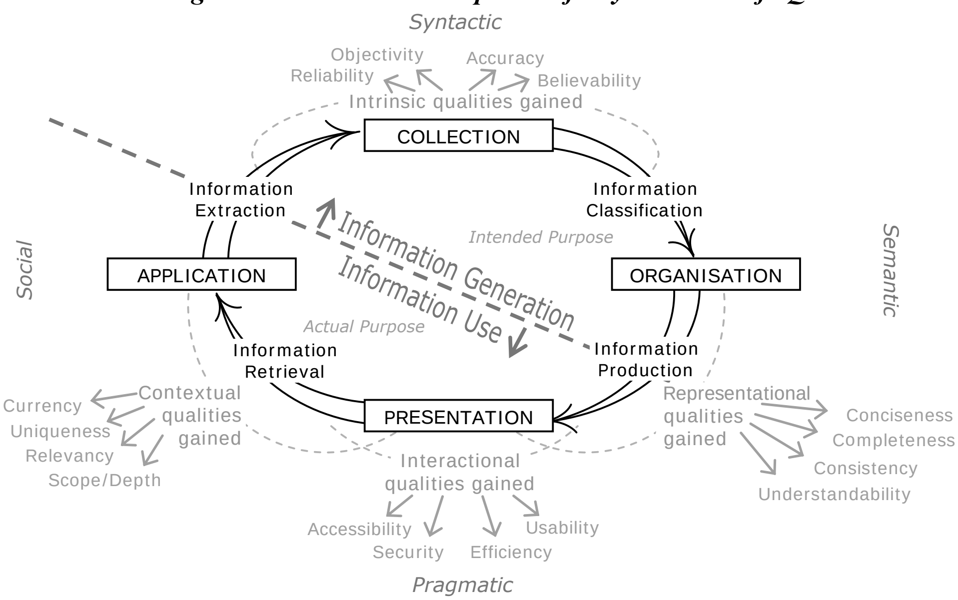
[1] see Knight & Spink [33] for a comprehensive review of the information behaviour literature engaged as part of this study

encounter, since it tells us something of the task and/or context of the information interaction. How these information actions fit into the life cycle is illustrated in figure 2, which presents the CCLC model of IQ.

INVESTIGATIVE FRAMEWORK:
CCLC: Combined Conceptual Life Cycle Model of IQ

The CCLC model was developed through the synthesis of numerous previous conceptual IQ frameworks, or parts there-of, examined as part of this study[2] however three models in particular provided robust conceptual scaffolding. Wang & Strong [74] informed the study in relation to categorising the 16 dimensions into conceptually similar types of IQ. Shanks & Corbitt‟s [60] influence can be seen in the superimposing of their four symbolic/process constructs of IQ (syntactic, semantic, pragmatic and social[3]) into the life cycle. And Liu & Chi‟s [42] concept of IQ as an evolving construct provided the contextual glue which allowed the model to develop its own contextually-driven framework of analyses.

Figure 2. Combined Conceptual Life Cycle Model of IQ



The over-arching assumption of the CCLC model is that IQ dimension importance and users‟ value-judgments made in relation to them is heavily dependent on where in the life cycle user/information interaction takes place. This is consistent with Wang & Strong‟s [74] contention that IQ, as a constructed object and value is essentially contextually driven. This contextual approach to conceptualising and then investigating user perceptions of IQ is mirrored in virtually all of the IQ frameworks presented in Appendix 1 where the cited authors first and foremost contextualise their investigation into either: (1) broad categories [74, 27, 14, 17]; (2) assessment classes/types [47, 78, 26, 42]; or (3) criteria/contexts [6, 23, 2, 60, 65, 61]. Thus, the CCLC follows this same approach, conceptualising the 16 IQ dimensions into four IQ Categories by clustering those dimensions into the context of an information life cycle. In so doing, it postulates that:

S-1: IQ dimensions are conceptually connected into four interrelated clusters, which have a collective and evolving impact within their cluster, as well as on the other three clusters;

S-2: Users' perceptions of IQ are driven, by and large, by where in the information life cycle the user and information interact;

---

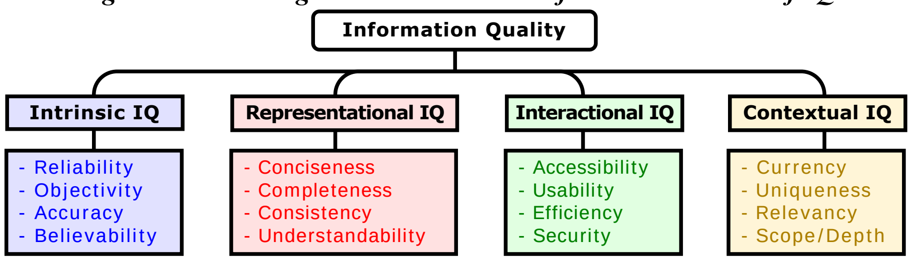
[2] Knight [34] provides a more comprehensive and theoretical discussion of the conceptual models visited for this study

[3] Subsequent semiotic models (Price & Shanks, [53, 54]) removed "social" however CCLC puts the social construct back

Intrinsic IQ

In the CCLC model of IQ, the intrinsic IQ category is seen as being determined during information generation and is constructed from the IQ dimensions of: (1) reliability; (2) accuracy; (3) objectivity; and (4) believability. As an early component of the information life cycle, the constructs associated with intrinsic IQ are considered essential characteristics and give the information its degree of integrity. As constructs, the dimensions of intrinsic IQ are built on observable characteristics such as authorship, which imply other attributes such as authority and reputation [28, 51]. Importantly, like the clusters of dimensions associated with each of the four IQ categories; reliability, accuracy, objectivity and believability are seen as being co-dimensions [45] of the same larger construct, in that not only are they often judged using the same information characteristics, but they often imply each other‟s presence. For example, *believability* describes the so called credibility of information, and like reliability, is intrinsically linked with characteristics such as authorship, and co-dimensions like accuracy and objectivity. So, a dimension such as reliability denotes the presence of dimensions such as objectivity, accuracy and believability, in that without these characteristics, information would be considered, by the discerning recipient, to be unreliable.

Figure 3: The Categories & Dimensions of the CCLC model of IQ



Representational IQ

The dimensions of: (1) conciseness; (2) completeness; (3) completeness; and (4) understandability; characterise the "representational" characteristics of IQ. Bovee *et al*., [7] contend that characteristics such as completeness and consistency represent the physically integrity IQ in the same way that the previously discussed intrinsic characteristics such as reliability and believability imply integrity IQ.

Representational IQ is summed up in the information‟s actual existence, in that the types of associated information characteristics, unlike intrinsic characteristics, require the information be viewed and examined in order for a value-judgment to be made. Thusly, the CCLC contends that the dimensions of conciseness, understandability, completeness and consistency are demonstrative of the skill level of the information producer. Moreover, they also engender the information retriever to engage their own skill-set when making value-judgments related to them. Put simply, *the user will make representational IQ value-judgments relative to their own cognitive ability and skill*.

Interactional IQ

In the CCLC the interactional characteristics of information are gained at the pragmatic [60, 54] or presentation [42] stage of the information life cycle. The model contends this is where users make value judgments of information according to their technical or interactive experience and skills, that is; the perceptive IQ value judgments made in regards to: (1) accessibility; (2) usability; (3) efficiency; and (4) security; relate to the motor aspects of user-information interaction, and include such characteristics as how easily information can be located and retrieved. Therefore user value-judgements do not relate to the actual content of information, but are made according to perceptions of IQ on the Web as an information environment. In addition, the model recognises that the criteria engaged in making value-judgements of interactional IQ dimensions are often opposites of the same entity for information producers as information receivers. For example, if an interactional value-judgment is made in relation to the „price/cost" of information, a receiver‟s judgement is made in relation to obtaining the data for as little cost as possible, but the information producer is concerned with the complete opposite, wishing to gain the highest price possible. The same principal often applies for other interactional IQ issues such as information accessibility, copyright and security.

Contextual IQ

Contextual IQ is made up of such IQ dimensions as; (1) currency; (2) uniqueness (innovativeness); (3) relevancy; and (4) scope/depth. Most often it relates to the topic/subject content of information, and is *directly related to the information needs of the information seeker* [71]. Where value-judgments are made of the dimensions associated with representational IQ according to the seekers own information skill, contextual IQ value-judgments are made according to what the seeker is specifically looking for. This direct relationship between contextual IQ dimensions and user information need may account for why the associated dimensions of contextual IQ have become a central focus in systems and Web IQ research, as they are the characteristics which best represent why the user is engaging the system.

Recent research into systems, and particularly Web IQ [17, 65, 69, 56, 61] have positioned the contextual IQ and interactional IQ related dimensions as central to information seekers‟ value-judgment processes. This view is mirrored in much of the information seeking behaviour (ISB) and information retrieval (IR) research, where the *'relevancy* dimension is considered of particular importance [12, 15, 44, 72, 75, 56].

Contextual IQ presents the greatest challenge to information producers because currency, relevancy, uniqueness, and scope/depth are highly relative. That is; the „right‟, or „right amount‟ of information or detail depends on contextual elements such as a seeker‟s individual information need [9, 52] and these are elements that the information producer may have little to no control over. For the information producer then, contextual IQ relies on them knowing their audience‟s information need, and becomes an important element of IQ production if the producer would have the seeker return or reuse their system/content [32].

Looping Life Cycle: The Inter-connectivity of IQ dimensions

Although the CCLC conceptualises 16 dimensions of IQ into four contextual categories associated with an information life cycle, the model also recognises the inter-connectivity of IQ dimensions in general. For example, as an „interactional IQ‟ characteristic of IQ, *efficiency* might typically represent the ease with which information can meet a user‟s information need, and be value-judged according to users being able to quickly find what they are looking for. This could also be conceptualised as „navigatability‟ and is therefore related to other interactional IQ dimensions such as usability and accessibility. However, efficiency also implies other information characteristics such as consistency and conciseness, which are classified in the CCLC as representational IQ dimensions. So, while as a framework the CCLC has been developed to guide the study‟s conceptual classification of the multi-dimensional phenomenon that is „information quality‟, the interactive user/information processes involved with information creation, presentation, seeking, value-judgements, and ultimate retrieval, and use and re-use, implore the model to recognise that information production and information use are a continuum .

METHODOLOGY:

Instrumentation: IQ Frequency & Impact Survey

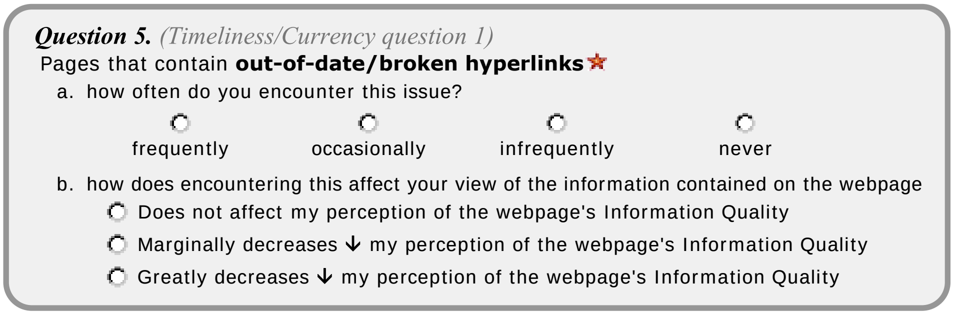
Eighty (80) „high-end‟[4] participants were asked to indicate: (1) how often they encountered a described problem; and (2) how encountering the problem impacted their general perception of IQ of the webpage. Figure 4 presents question 5[5], one of two questions used to test the „currency‟ dimension. Unlike in the example, users were not informed which dimension was being tested, they were simply asked to indicate how *frequently* they encountered the described scenario, and to select how encountering the problem was

[4] „High-end‟ users: all participants were career-researching academics or PhD candidates who frequently engaged the Web as part of their information retrieval (IR) strategies in their work/research.

[5] (Q.5 from survey #4). The whole study involved 109 questions, in 4 surveys, plus one registration/demographic form. Survey #4: on IQ perceptions (total 70 questions with results for part B, i.e., 32 freq/impact Q‟s used in this paper)

likely to *impact their overall perception* of the quality of the webpage(s).

Figure 4: Example of question in the IQ-Frequency & Impacts Survey


Question 5. *(Timeliness/Currency question 1)*
Pages that contain **out-of-date/broken hyperlinks**
a. how often do you encounter this issue?
frequently occasionally infrequently never
b. how does encountering this affect your view of the information contained on the webpage
Does not affect my perception of the webpage's Information Quality
Marginally decreases ↓ my perception of the webpage's Information Quality
Greatly decreases ↓ my perception of the webpage's Information Quality

The IQ dimension Questions

The sixteen (16) IQ dimensions identified from the literature (see Table 1) were conceptualised into a set of 32 questions (see Table 2) – with each of the dimensions being tested twice. The pilot study had shown that users found it easier to describe what IQ was not, rather than what it was, so each dimension was described in terms of two possible (negative) scenarios typically encountered by users on the Web. For example, a lack of „accuracy" was described as: (i) a page that contain numerous spelling errors; and (ii) information that is incorrect.

Table 2: The sixteen dimensions tested in Survey #4 (Information Quality)

Category	Dimension	Question
Intrinsic IQ	Reliability	(Q.1) Information that lacks an attributed author (Q.2) Information that seems unreliable
	Objectivity	(Q.17) Information that is bias in nature (Q.18) Information that does not attempt sustain itself (e.g.; reference etc)
	Accuracy	(Q.3) Pages that contain numerous spelling errors (Q.4) Information that is incorrect
	Believability	(Q.29) Information that is clearly erroneous (Q.30) Information that lacks credibility
Representational IQ	Conciseness	(Q.25) Long winded, unfocused information (Q.26) Information that contains poor grammar
	Completeness	(Q.21) Information that is not complete (Q.22) "Under Construction" or "Coming Soon" statements
	Consistency	(Q.15) Information that seems disjointed and difficult to follow (Q.16) Information that seems out of place (in the context of a website)
	Understandability	(Q.19) Poorly written information (Q.20) Information that is difficult to understand
Interactional IQ	Accessibility	(Q.11) Information aimed at the wrong audience (in the context of a website) (Q.12) Information that is difficult to read
	Usability	(Q.13) Web pages that are difficult to navigate (Q.14) Information that is hard to find
	Efficiency	(Q.31) Information that doesn't meet your information needs (Q.32) Content that takes and a long time to download
	Security	(Q.23) Un-secure/unprotected info (i.e.; sensitive info that should be protected) (Q.24) Information that probably breaches copyright laws
Contextual IQ	Currency	(Q.5) Pages that contain out-of-date/broken hyperlinks (Q.6) Out-of-date information
	Uniqueness	(Q.27) Information that is highly repetitive (Q.28) Un-inspired, boring information (nothing new or innovative)
	Relevancy	(Q.9) Irrelevant Information (Q.10) Unhelpful information
	Scope/Depth	(Q.7) Too much information (Q.8) Too little information

Table 2 lists each question used to test the specific IQ dimensions. It should be noted that a contention of this research, and the evidence of the results suggests that perceptions of IQ dimensions, in all likelihood, do not exist as islands, but are inter-connected and fluid. In addition, some described scenarios could easily be included as testing other dimensions. There were at least six scenarios, for example, that could have been used to test participants" perception of *relevancy*, including: (Q.9) irrelevant information [tested relevancy]; (Q.10) unhelpful information [tested relevancy]; (Q.16) information that seems out of place [Consistency]; (Q.11) information aimed at the wrong audience [accessibility]; (Q.25) long winded, unfocused information [conciseness]; (Q.31) information that doesn't meet your information needs [efficiency]. Given the time to continue with the research, a deeper level of data analysis could be used to strengthen and validate current results regarding specific dimensions of IQ, as well as provide an avenue for further research.

The IQ Dimensions Rating Scale

The choice to examine both the frequency (called „frequency score" [*FS*]) and the impact (called „Impact score" [*IS*]) of encountering IQ problems on the Web was made in order to understand more than just the actual information deficits typically encountered in a Web environment. For example, knowing that a page might contain broken hyperlinks is not enough to determine the quality of a webpage in that the study needed to understand the significance of those broken hyperlinks to a user"s perception of the quality of that webpage. This approach is consistent with the theory associated with IQ being a relative, contextual construct, but more importantly allows the study to begin to identify if some IQ sub-dimensions are more important to users general IQ perceptions than others. It does this by attaching a weighted formula („Perception of Web-IQ") i.e., a numerical value, developed from both the frequency and impact/effect data, to each of the 16 tested dimensions, allowing results to different dimensions to be compared against each other.

The **Perception Web-IQ** Score for each dimension was calculated using a weighted formula for both a 'frequency score' (*FS*) and impact score' (*IS*), divided by α (α = number of scores used, in this case; $\alpha = 2$):

i.e., $\{ \mathbf{[FS]} + \mathbf{[IS]} \} \div \alpha$ **= Web-IQ dimension score**

The **FS** weighted formula was based on the logic that:

(1) *an increased frequency should result in a higher FS*: i.e., each user result for a specific IQ problem being encountered frequently [=Fq] should receive a higher *FS* weighting than an IQ problem encountered occasionally [=Oc] or infrequently [=InF], with never [=N] being the only way to lower the score. The result is then divided by δ ($\delta = 4$):

i.e., $\{ \mathbf{[Fq] \times 3 + [Oc] \times 2 + [InF] \times 1 + [N] \times -2} \} \div \delta = \mathbf{(FS)}$

The **IS** weighted formula was based on the logic that:

(2) *greater impact on IQ should result in a higher IS*: i.e., if the impact of encountering a specific IQ characteristic greatly decreases [=Gt] the user's perception of the page's IQ, it should receive a higher weighted IS than if it marginally decreases [=Mg] the user's IQ perception. In addition, if a user recorded encountering a specific problem as having „no effect" [=Ni] on their perceptions of IQ, then the result should impact the *IS* score positively (to lower the score). Then divided by η (η=3).

i.e., $\{ \mathbf{[Ni] \times -2 + [Mg] \times 1 + [Gt] \times 2} \} \div \eta = \mathbf{(IS)}$

The construction of the data collection and analysis was such that figures could be analysed in the context of three levels of IQ; namely: (1) *IQ issues* – the individual problem encountered, of which 32 were tested; (2) *IQ dimensions* – the 16 dimensions of IQ, each represented by two tested problems; and (3) *IQ Categories* – the type of IQ conceptualised from groups of IQ dimensions. In addition, users IQ results could be analysed from three perspectives, namely: (1) Most *frequently encountered* [FS] IQ issue, dimension or category; (2) Most *impacting* IQ issue, dimension or category; and (3) Most important *perceived Web- IQ* issue, dimension or category (calculated from results to #1 and #2).

The Target User Group

The target user-group needed to be a relatively intellectually sophisticated group of users who demand a high level of quality in the information they retrieve from the Web. An assumption was made that career academics and thesis level university students – often members of academia themselves – would possess a relatively high degree of IQ perception, enjoying the ability and need to make relevant quality related judgments of the information they encounter on the Web. They would also have a relatively high degree of cognitive awareness, and exhibit the capacity to articulate their strategies in relation to the decision-making processes involved in information search and retrieval on the Web.

Once it was determined such a skill-set and information demand might be found amongst „academic“ users, a call for participation was sent out to multiple university organisations, on-line academic community groups and list-servers, asking for: (1) users who were career academics or postgraduate level students – including users who fell into both these categories; and (2) users who frequently engaged the Web to retrieve information that related to their work and/or research. Participants did not necessarily have to feel „comfortable“ retrieving work/research related information from the Web, but needed to do so relatively regularly and be personally familiar with the process of using the Web as an information retrieval tool for the high quality content associated with their work. In addition, users who engage the Web as a means of professional networking, or even entertainment were not excluded from the target user-group, however the surveys and questionnaires they completed did not relate to these interactions.

DISCUSSION:

Information Quality (Dimensions) Score Results

Table 3 presents the overall results for the each of the 32 IQ issues tested. Column 1 lists the 32 issues examined as part of the study; column 2 (a-d) lists results in percentage for how frequently the users encountered the issue from column 1. Column 3 (a-c) records the degree to which each described problem impacts users“ perceptions of IQ when they encounter it on the Web. The weighted scores are then presented in columns 4, 5 and 6, followed by an indicator of which category and dimension of IQ was being examined.

Table 3: User Results for IQ issues, dimensions & categories

	How often issue/problem encountered (%)				Impact on perception of IQ (%)							
Question	FRQ	OCS	InFRQ	Nev	Nil Effect	Marg ↓	Great ↓	Freq Score	Impact Score	Perception Web IQ	Category/Dimension	Score/Rank
(Q.1) Info lacks attributed author	48	44	9	0	6	58	36	60.25	39.33	49.79	Intrinsic IQ:	
(Q.2) Info that seems unreliable	24	61	15	0	1	15	84	52.25	60.33	56.29	reliability	53.0 [1]
(Q.3) contains numerous spelling errors	15	49	34	2	6	24	70	43.25	50.67	46.96	Intrinsic IQ:	
(Q.4) Information that is incorrect	8	62	29	1	1	12	86	43.75	60.67	52.21	accuracy	49.6 [2]
(Q.17) Info bias in nature	28	55	18	0	11	48	41	53.00	36.00	44.50	Intrinsic IQ:	
(Q.18) Info not attempt sustain itself	42	42	12	2	9	36	55	54.50	42.67	48.58	objectivity	46.5 [3]
(Q.29) Info that is clearly erroneous	2	38	55	5	4	6	90	31.75	59.33	45.54	Intrinsic IQ:	
(Q.30) Information that lacks credibility	6	61	32	0	4	15	81	43.00	56.33	49.67	believability	47.6 [4]
(Q.25) Long winded, unfocused information	10	51	39	0	8	49	44	42.75	40.33	41.54	Representational IQ:	
(Q.26) contains poor grammar	18	52	29	1	9	28	64	46.25	46.00	46.13	conciseness	43.8 [5]
(Q.19) Poorly written information	21	65	14	0	4	24	72	51.75	53.33	52.54	Representational IQ:	
(Q.20) Info that is difficult to understand	11	59	29	1	36	45	19	44.50	3.67	24.08	understandability	38.3 [6]
(Q.21) Information that is not complete	21	56	21	1	14	44	42	48.50	33.33	40.92	Representational IQ:	
(Q.22) "Under Construction/Coming Soon"	21	49	29	1	34	32	34	47.00	10.67	28.83	completeness	34.9 [8]
(Q.15) disjointed and difficult to follow	10	54	35	1	5	50	45	42.75	43.33	43.04	Representational IQ:	
(Q.16) Info that seems out of place	2	42	45	10	24	49	28	28.75	19.00	23.88	consistency	33.5 [10]
(Q.13) Difficult to navigate	28	61	11	0	41	31	28	54.25	1.67	27.96	Interactional IQ:	
(Q.14) Information that is hard to find	34	55	10	1	48	31	21	55.00	-7.67	23.67	usability	25.8 [12]
(Q.11) Aimed at the wrong audience	9	42	39	10	32	40	28	32.50	10.67	21.58	Interactional IQ:	
(Q.12) info that is difficult to read	6	56	34	4	21	41	38	39.00	25.00	32.00	accessibility	26.8 [13]
(Q.31) Doesn't meet information needs	58	39	4	0	56	24	20	64.00	-16.00	24.00	Interactional IQ:	
(Q.32) Takes a long time to download	10	55	32	2	65	21	14	42.00	-27.00	7.50	efficiency	15.8 [14]
(Q.23) Un-secure/unprotected information	2	22	42	32	40	19	41	7.00	7.00	7.00	Interactional IQ:	
(Q.24) breaches copyright laws	9	42	40	9	41	32	26	33.25	0.67	16.96	security	12.0 [16]
(Q.5) Out-of-date/broken hyperlinks	22	68	10	0	31	51	18	53.00	8.33	30.67	Contextual IQ:	
(Q.6) Out-of-date information	15	68	18	0	10	61	29	49.75	33.00	41.38	currency	36.0 [7]
(Q.27) highly repetitive	12	55	31	1	14	45	41	43.75	33.00	38.38	Contextual IQ:	
(Q.28) Un-inspired, boring information	24	56	20	0	40	30	30	51.00	3.33	27.17	uniqueness	32.8 [9]
(Q.9) Irrelevant Information	19	58	22	1	32	42	25	48.25	9.33	28.79	Contextual IQ:	
(Q.10) Unhelpful information	29	58	12	1	42	31	26	53.25	-0.33	26.46	relevancy	27.6 [11]
(Q.7) Too much information	15	38	36	11	76	22	1	33.75	-42.67	-4.46	Contextual IQ:	
(Q.8) Too little information	31	52	16	0	26	42	31	53.25	17.33	35.29	scope/depth	15.4 [15]

Some General Observations & Findings

 # A weighted impact score is required to better understand User Perceptions of Web IQ

The overall results demonstrate that including an „impact score" as part of each Web-IQ dimension score is highly important to understanding how various information characteristics impact users perceptions of quality on the Web. For example, users" most frequently encountered IQ problem was *finding information that didn't meet their information need* (Q.31), however its impact on their IQ perceptions when this occurred was relatively minimal (ranking 23rd out of the 32 issues tested), so the weighted Web-IQ score positions this problem as relatively unimportant to user Web IQ perceptions. This specific result seems to offer support to previous literature which suggests users take into account the information environment (or context) when making value judgments about IQ. In this case, the sheer size and volume of data available on the Web means that users seem prepared to encounter information that is not quite what they want on their journey towards finding their target data, without it significantly impacting their perception of the IQ. Indeed, numerous results from the study indicate that *users demonstrated a high degree of cognitive tolerance for Web-specific IQ issues*.

 # Users' Exhibit Cognitive Tolerance for Web-specific IQ issues

Web-specific IQ issues are those encountered simply because the user is interacting with information in the World Wide Web environment. The user group"s general cognitive tolerance for these problems was recorded as exceedingly high given how often users" claim to encounter these types of problems. Some examples include:

1. Nearly a quarter (22%) of users said they frequently encounter Web pages with broken hyperlinks yet a staggering 81% of them said this made little to no difference to their perception of the page"s IQ.
2. Likewise, more than half (60%) of users frequently found themselves interacting with information which did not meet their actual information need, yet only 20% of them said this would adversely impact their perception of the webpage/site"s IQ.
3. Users seemed particularly forgiving of technical issues such as *slow downloading times* (86% said this did not impact perceived IQ); pages which proved *difficult to navigate* (79% said little to no impact on perceived IQ); blatant *breaches to copyright* (74% said little to no impact); *under construction* notifications (72%, little to no impact).
5. Participants were more than 75% more likely to be negatively impact by content being out-of-date if it was not specifically an out-of-date hyperlink
4. Perhaps most telling – in this generation of information over-load – users were almost completely unfazed (76% nil impact, 22% marginal impact) when confronted with too much data/information.

IQ Score Results: Support for the CCLC Model of IQ

Earlier in this paper, the following proposition was stated as being a central assumption of the CCLC:

S-2. Users' perceptions of IQ are driven, by and large, by where in the information life cycle the user and information interact;

The supposition had been made as part of a theoretical framework designed to help conceptualise the context of user-information interaction within an information life cycle. When user results are examined, not only is the postulate confirmed, but the data actually reveals at least one of the ways this happens:

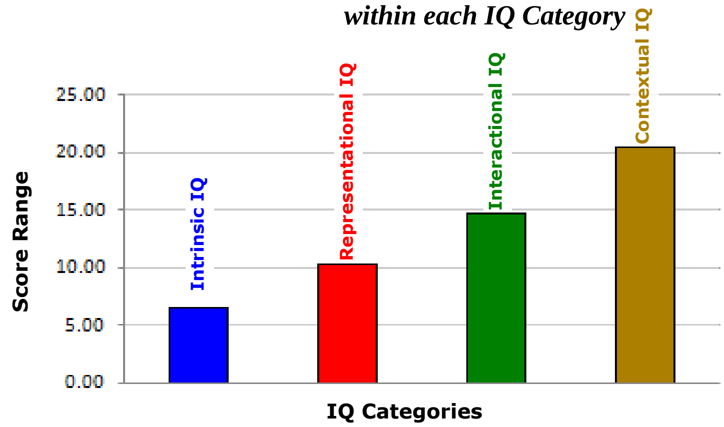
S-3. Users perception of what IQ is, grows increasingly varied (between users) the further into the IQ life cycle that information travels or information/interaction takes place.

 # Perceptions of Web-IQ diverge the further into the Information Life Cycle.

The CCLC proposes that *Intrinsic IQ* dimensions are gained by information at the earliest point in the information life cycle as part of information generation (*see figure 2 for visual*). Also a part of information generation is information classification, organisation and production – and this is where *Representational IQ* dimensions are gained. Retrievers of information also begin to interact with the information at this stage of the information life cycle, and thus use their own cognitive ability and skill to make decisions about the intrinsic and representational IQ characteristics of the data. *Interactional IQ*, i.e., accessibility, efficiency, usability and security; relate to the *motor* processes of information interaction; while the relevancy, currency, uniqueness and scope dimensions of *Contextual IQ* relate to users cognitive choices regarding the content of the information interaction.

Figure 5 illustrates how the variation (or range of responses) in users perceptions of Web-IQ increases the further into the information life cycle the user interacts with the data. Another way of looking at this would be to say that: *Users' perceptions of Web-IQ diverge the closer they get to their target information.* Importantly, as this happens, the impact on IQ perceptions of this divergence proportionally decreases until such times as the user – as an information retriever – begins to generate new information; thereby changing their role from retriever to producer.

Figure 5: Variables between Web-IQ Scores within each IQ Category



 # Impact of IQ dimensions on Web-IQ perception decreases the closer users get to target information

The statistics recorded in Table 2 illustrate that the major reason for the decline in dimensional IQ importance to users Web-IQ perceptions is not related to how frequently an IQ issue is encountered on the Web, but as a result of a steady decline in the *impact* on user IQ perceptions (*see figure 6*). Thus:

S-4. The impact of IQ dimensions on Web-IQ perception in not related to problem frequency; and

S-5. The negative impact of users' encountering problems with IQ diminishes the further into the IQ life cycle that user/information interaction takes place.

The author contends that both the increasing divergence of Web IQ perceptions and their decreasing impact occurs because as the information retriever moves deeper into the IQ life cycle they get closer to their target information and therefore move away from more general perceptions of IQ towards an increasing specificity pertaining to their individual information need(s). It would seem from this that users carry much of the cognitive responsibility for finding and retrieving information from the Web, and are relatively forgiving of the Web‟s known short-comings. This is an important point, since it re-aligns Web-IQ studies towards intrinsic and representational IQ characteristics being of critical importance to user perceptions of Web-IQ during a period in the research where contextual [65, 69, 56] and usability issues [49, 29, 75] have become the dominant IQ constructs.

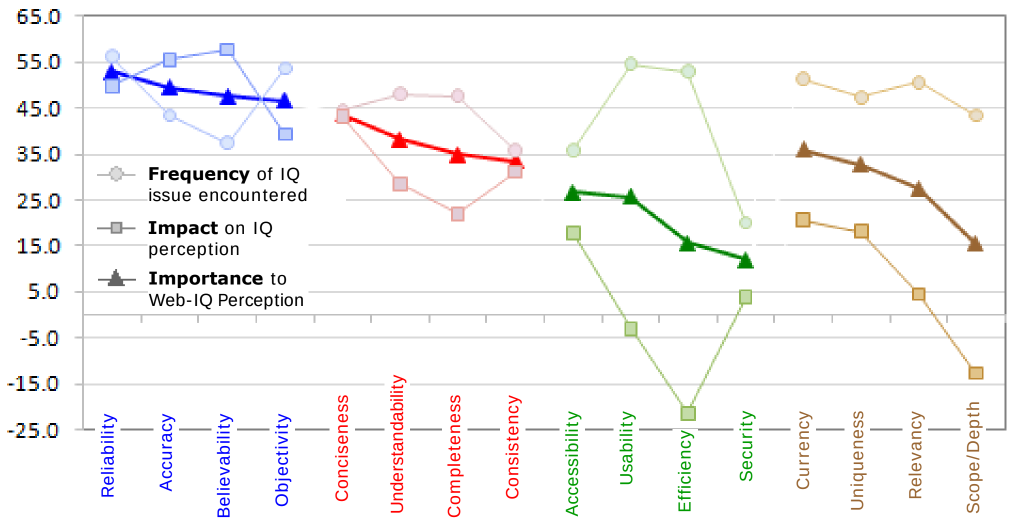
Some Contributions & Implications

In the first instance, the data in this study is empirically supportive of Wang & Strong‟s [74] original conceptualisation of IQ into four categories of associated dimensions. Figure 6 illustrates how the user perception patterns vary markedly between the four constructed categories. In the case of the CCLC, the naming of the categories was made vocabulary consistent: i.e., (1) Intrinsic IQ; (2) Representational IQ; (3) Interactional IQ; and (4) Contextual IQ (*see figure 3*).

Intrinsic IQ: demonstrated itself to be the most important IQ category – with all four dimensions ranked in the top 4. It is also the least influenced by the contextual/subjective characteristics of the system in which the information was disseminated or retrieved. That is, it is the least context specific IQ construct to where information is encountered in the life cycle. It should be noted, that although objectivity caused the least concern for this user group, results to the survey questions (Survey #3) about the group‟s Information Seeking Behaviour (ISB) suggested that the user population had a higher than normal degree of tolerance for biased information.

Representational IQ: Cross analysis of the results for representational IQ constructs against user demographic, professional and information-task statistics (see footnote 4) demonstrated that value-judgments assigned to representational IQ characteristics by the receivers of information are most influenced by the users‟ own cognitive and information skills and abilities. An implication of this is that information producers should be aware of their audience‟s skill-level; since *the level of skill of the information receiver, places specific demands on the dimensions associated with representational IQ*. This is an important point, since although deficiencies in representational IQ dimensions are generally encountered less frequently than contextual or interactional IQ issues, they accounted for four of the top 10 most negative impacts on users perceptions of IQ.

Figure 6: Frequency of IQ issue, their impact on, and importance to user Web-IQ perception



Interactional IQ: The range of results for interactional IQ dimensions diverged significantly compared with the previous IQ categories. Consistent with usability becoming such a key issue in the Web IR and IQ literature [49, 37], participants identified the issues associated with *usability* as their 3rd (information that is hard to find) and 5th (information that is difficult to navigate) most frequently encountered web IQ problem. However, like a number of other contextual and interactional IQ problems associated with the Web, the actual impact of encountering these difficulties turned out to be relatively minor, ranking 30 and 26th out of 32 respectively.

Contextual IQ: Contextual IQ related issues were cited as some of the most commonly encountered problems on Web, with users coming across them 9% more often than representational IQ issues, 16% more frequently than interactional IQ problems, and 1.3% more frequently than the critical intrinsic IQ issues. User value-judgments of the dimensions associated with contextual IQ were, by and large, information need (contextually) driven and profoundly influenced by relative user constructs such as their *Attribution* tendencies and motivation to engage information[6]. This could explain the high prominence of the relevancy construct in recent Web IR and IQ research [12, 29, 44, 75]. The negative impact of encountering unhelpful or irrelevant information, however, is relatively small, which the author contends, renders relevancy – as a construct – a cognitive process which most users engage at a non-

[6] This is known from cross analysis with the results for surveys 1, 2 & 3 [32] – which are discussed further in [35]

affective level. That is; relevancy is rarely used to make *quality* related value-judgments about information which users encounter.

As expected, the high specificity of user perceptions in relation to contextual IQ with users" information task/context, provided valuable cross-analysis fodder with the ISB survey results. For example: users who principally engage the Web for industry related information tasks valued „*uniqueness/innovativeness*" above other contextual qualities, users who predominately search for academic resources valued „*currency'* the most, and users who chiefly engage Web-only information tasks, such as online news and magazines, placed a higher value on „*relevancy'*.

Limitations & Future Research

There are a number of limitations associated with the research which may have impacted user results in relatively predictable ways. These include: (1) The relatively small size of the user-group; (2) The narrow sample (academics only); and (3) The broad nature of the investigation.

User group Limitations

The target participants for the research were classified as high-end information users, namely; career academics and dissertation level researchers. In addition, although not a goal of the research in that no pre-defined minimum level of user Web „experience" was used as an inclusion criteria, the users were all highly experienced in using Web technology for information retrieval. All participants had been using the Web and its search engines since before 2004, with the vast majority (95%) having used search engines previous to 2001. In fact, nearly three quarters had been using Web search engine technologies since before Google, and – even more remarkable, over a fifth of the user-group had been using Web technologies since before 1995, making them some of the earliest adopters of the global technologies that would become the World Wide Web. In short, results from the study"s associated surveys [32] demonstrated this user-group to be: (1) highly experienced in Web IR; (2) technically Web and search engine savvy; and (3) confident in their own ability to successfully find their target information.

Representational IQ results: It is likely that the user-group makeup has positively impacted representational IQ results in that the cognitive skills associated with the group is expected to be significantly higher than average. Of course the study in no way advocates that academia holds a monopoly on intelligent individuals or high-end information users. It simply assumed that, in order to participate in post-graduate academic activities, the vast majority of users would posses above average cognitive capabilities and demand a high level of quality in their target information. Given that the study wished to learn about IQ related decision making processes, this over weighting towards high-cognition users was considered necessary to the investigation. It also acted to narrow of the internal user-group variables, therefore improving the internal validity of user results. Replication of the study using a different user-population might be necessary to determine the degree of generalisability of findings to other user populations.

Interactional IQ results: It is possible that the extremely high levels of user Web and Search Engine experience reported by the user group is a contributing factor to the study"s finding that users demonstrate a remarkable cognitive tolerance for Web-specific IQ issues, however as the „novice" Web user becomes a dying breed, the Interactional IQ results may find themselves increasingly applicable to a more general audience. In addition, future research associated with the current study and data has the capacity to sub-divide the user-group according to Web experience levels (recorded in the user registration form) to determine whether this impacts Interactional IQ results.

Conceptual Construction Limitations

The author recognises that the conceptualisation of IQ into a set of meaningful, measurable dimensions is fraught with the danger of over-simplifying what amounts to a multi-dimensional construct [3, 29, 1, 22] made up of numerous inter-connected, affective parts, which are consciously and unconsciously heterogeneously engaged during user/information interaction. In this regard, the itemising of individual dimensions into a most-to-least important list of user-driven IQ criteria is ultimately meaningless without developing a degree of understanding of how at least some of the „parts" work together in impacting users" IQ perceptions. The dimension „efficacy" illustrates this inter-connectivity of IQ dimensions well. As a dimension of the interactional IQ category, efficiency implies other interactional characteristics such usability and accessibility. As a characteristic of information however, efficacy also implies other characteristics such as consistency and conciseness – which are classified as representational IQ dimensions.

The user results discussed in this paper come, by and large, from the data associated with 32 specific questions regarding user-encountered Web IQ issues, and represents less than one third of the data associated with the project at large. It is hoped that future research will bring together more parts of the study to provide a greater contextual understanding of the multi-dimensional phenomena that is user perceptions of information quality.

Future Research

Presented in the current paper are the whole-group participant results for the IQ dimension aspects of a study investigating user perceptions of IQ in Web IR behaviour. The relatively strong internal validity associated with the participant group and collected data will provide a number of robust ways to examine variations in user results according to individual differences within the target participant group. Some of these differences were anticipated – from previous literature – and were included in the design of the registration form and four surveys investigating:

(1) user perceptions of their interactions with, and expected outcomes from, web technologies;
(2) user perceptions of their interactions with, and expected outcomes from, search engines;
(3) general IR strategies employed while looking for information in a Web environment;
(4a) user perceptions of Web IQ; (4b) perceptions when encountering IQ related problems on the Web.

Other individual differences between participants revealed themselves in the early stages of data review and analysis. These were gleaned from participant results to some of the 109 questions answered.

The various individual differences provide interesting partition points for data analysis, allowing for a number of new research questions. Future research associated with the study then, will include analyses of whether and how some of the following constructs might impact user perceptions of Web-IQ: (1) user level of experience; (2) type of information being sought; (3) cognitive style in information search strategies; (4) expectations of IR strategy outcomes; (5) academic role; (6) academic discipline; (7) user self-efficacy; and more. For example, a preliminary review of the data demonstrates that a user"s information task can cause their perceptions of IQ to vary by around 36% from normal variation. Specifically, users" target information can have a profound impact on how users perceive and approach whole categories of IQ. Users" *age* also seems to have a significant influence on perceptions of IQ (28% variance) although further analysis is required to see whether this a direct relationship or through age"s influence on other constructs such as *academic role* or *information task*. So too, Users" *academic discipline* (24%) appears to significantly influence Web-IQ perceptions – which again might provide fertile ground for future research.

CONCLUSION:

The proposed CCLC model of IQ seeks to contextualise user/information interaction in a way that provides a better investigative framework from which to examine user perceptions of IQ. By conceptualising user perceptions of IQ in terms of the information life cycle, the model is able to demonstrate where in the information life cycle users are most likely to engage specific perceptions of IQ, and predict the relative impact those perception might have on the user"s general perception of IQ.

Structurally, the model is comparable to Wang & Strong"s [74] in that it conceptualises the IQ dimensions into four IQ categories, although there has been a vocabulary shift with all four categories *adjective* named. This is consistent with the conceptual building of investigative frameworks. Conceptually, the model is like Liu & Chi"s [42] in that is sees IQ in terms of the information life cycle and contends that users engage specific dimensions of IQ at various stages of information interaction during this life cycle. The user results discussed in this article are not only consistent with the above postulate, but also reveal something of how users engage the dimensions and how these dimensions impact on more general user perceptions of IQ during information retrieval on the Web.

It is acknowledged that the need to engage a user-group with a high degree of cognitive ability and high demand on quality characteristics of the information they typically seek, means the study should now be replicated in different user-group populations to determine its degree of generalisability to all IQ contexts. In addition, a new user-group associated with the newer social/professional networking uses of the Web might provide a promising investigative context for the CCLC model given that this cohort blurs the lines between information generation and information retrieval in ways not seen in information interaction before.

ACKNOWLEDGEMENTS:

This research comes from the PhD "*User Perceptions of Information Quality in World Wide Web Information Retrieval Behaviours*" and was generously funded as part of the ARC-Discovery Project DP0452862: "Building an Internet Search Engine for Quality Information Retrieval". The author would like to acknowledge the support of Professor Janice Burn, who supervised the PhD and provided much mentorship and input between 2005 and 2008. Thanks also to the other project researchers at University of Wollongong.

REFERENCES

[1] Aladwani, A. M., & Palvia, P. C. (2002). Developing and validating an instrument for measuring user-perceived web quality. *Information & Management, 39*(6), p467 - 476.

[2] Alexander, J. E., & Tate, M. A. (1999). Web wisdom: how to evaluate and create information quality on the web. *Mahwah, NJ: Erlbaum*.

[3] Ballou, D. P., Wang, R., Pazer, H.L., & Tayi G.K. (1998) Modelling Information Manufacturing Systems to Determine Information Product Quality. *Management Science, 44*(4).

[4] Bates, M. J. (1989). The design of browsing and berrypicking techniques for the on-line search interface. *on-line Review, 13*(5), pp.407-431.

[5] Bates, M. J. (2002). The Cascade of Interactions in the Digital Library Interface. *Information Processing and Management, 38*, pp.381-400.

[6] Beck, S. (1997). Evaluation criteria: the good, the bad & the ugly; or why it's a good idea to evaluate Web sources. http://lib.nmsu.edu/instruction/evalcrit.html

[7] Bovee, M., Srivastava, R. P., & Mak, B. (2003). A conceptual framework and belief-function approach to assessing overall information quality. *International Journal of Intelligent Systems, 18*(1), 51-74.

[8] Brooks, T. A. (2003). Web search: how the Web has changed information retrieval. *Information Research, 8*(3).

[9] Bryant, S. L. (2000). The information needs and information seeking behaviour of family doctors: a selective literature review. *Health Libraries Review, 17*(2), 83-90.

[10] Chang, I. C., Li, Y.-C., Hung, W.-F., & Hwang, H.-G. (2005). An empirical study on the impact of quality antecedents on tax payers' acceptance of Internet tax-filing systems. *Government Information Quarterly, 22*(3), 389-410.

[11] Chung, W. Y., Fisher, C., & Wang, R. (2002). What Skills Matter in Data Quality. *Proc. of the 7th International Conference on Information Quality, (MIT IQ Conference)*, 331-342.

[12] Cosijn, E., & Ingwersen, P. (2000). Dimensions of relevance. *Information Processing & Management, 36*(4), 533-550.

[13] Croft, D. R., & Peterson, M. W. (2002). An evaluation of the quality and contents of asthma education on the world wide web. *Chest [NLM - MEDLINE], 121*(4), 1301.

[14] Dedeke, A. (2000). A Conceptual Framework for Developing Quality Measures for Information Systems. *Proc. of 5th International Conference on information quality*, 126-128.

[15] Dziadosz, S., & Chandrasekar, R. (2002). Do Thumbnail Previews Help users Make Better Relevance Decisions about Web Search Results? *Proc. of the 25th Annual International ACM SIGIR Conference on Research and Development in information retrieval, Tampere, Finland*, p.365 - 366.

[16] Eppler, M. J., & Wittig, D. (2000). Conceptualizing information quality: A Review of information quality Frameworks from the Last Ten Years. *Proc. of 5th International Conference on information quality*, p.83-96.

[17] Eppler, M., & Muenzenmayer, P. (2002). Measuring information quality in the Web Context: A Survey of State-of-the-Art Instruments and an Application Methodology. *Proc. of 7th International Conference on information quality*, 187-196.
[18] Even, A., & Shankaranarayanan, G. (2005). Value-Driven Data Quality Assessment. *10th International Conference on Information Quality*.
[19] Fidel, R., Pejtersen, A. M., Cleal, B., & Bruce, H. (2004). A Multidimensional Approach to the Study of Human-Information Interaction: A Case Study of Collaborative Information Retrieval. *Journal of the American Society for Information Science & Technology, 55*(11), 939–953.
[20] Forslund, H. (2007). Measuring information quality in the order fulfilment process. *International Journal of Quality & Reliability Management, 24*(5), 515-524.
[21] Gaizauskas, R. & Robertson, A. (1997). Coupling information retrieval & Information Extraction: A New Text Technology for Gathering Information from the Web. *Proc. of RIAO 97: Computer-Assisted Information Searching on the Internet,, Montreal, Canada*, 356-370.
[22] Gendron, M., Shanks, G., & Alampi, J. (2004). Next Steps in Understanding Information Quality and Its Effect on Decision Making and Organizational Effectiveness. *Proc. of DSS 2004 Conference*, 283 - 294.
[23] Harris, R. (1997). Evaluating Internet Research Sources. Virtual Salt - http://www.virtualsalt.com/evalu8it.htm, Viewed: Feb 2005.
[24] Hawkins, D. T. (1999). What is Credible Information? *ONLINE Magazine, 23*(5), pp.86-89.
[25] Hernon, P. (1994). Information life cycle: Its place in the management of U.S. government information resources. *Government Information Quarterly, 11*(2), 143-170.
[26] Kahn, B. K., Strong, D. M., & Wang, R. Y. (2002). Information quality benchmarks: product and service performance. *Communications of the ACM, 45*(4), 184 - 192.
[27] Katerattanakul, P., & Siau, K. (1999). Measuring information quality of web sites: development of an instrument. *Proc. of the 20th International Conference on Information Systems (ICIS'99), Charlotte, North Carolina, United States*, 279-285.
[28] Keast, G., Toms, E. G., & Cherry, J. (2001). Measuring the Reputation of Web Sites: A Preliminary Exploration. *Joint Conference on Digital Libraries (JCDL'01), June 24-28, Roanoke, Virginia, United States*, 77-78.
[29] Klein, B. D. (2001). user perceptions of data quality: Internet and traditional text sources. *Journal of Computer Information Systems, 41*(4), 9-18.
[30] Klein, B. D. (2002a). When Do users Detect information quality Problems On The World Wide Web? *8th Americas Conference on Information Systems*, 1101-1103.
[31] Knight, S. A., & Burn, J. M. (2005). Developing a Framework for Assessing Information Quality on the World Wide Web. *Informing Science, 8*, 159-172.
[32] Knight, S. A. (2008). User perceptions of information quality in World Wide Web information retrieval behaviour. *Doctoral dissertation, School of MIS, Edith Cowan University*.
[33] Knight, S. A., & Spink, A. (2008). Toward a Web Search Information Behavior Model. *in A. Spink & M. Zimmer (Eds) Web Search: Multidisciplinary Perspectives, Berlin, Springer*, 209-234.
[34] Knight, S.A. (2011). The Combined Conceptual Life-Cycle Model of Information Quality: Part 1, An Investigative Framework. *International Journal of Information Quality, 2(3),* 205-230
[35] Knight, S. A., & Burn, J. M. (2011). A Preliminary Introduction to the OTAM: Exploring Users‟ Perceptions of their On-going Interaction with Adopted Technologies. *Australasian Journal of Information Systems, 17(*1)
[36] Kovac, R., & Weickert, C. (2002). Starting with Quality: Using TDQM in a Start-Up Organization. *Proc. of the 7th International Conference on Information Quality, MIT IQ Conference, 2002*, 69-78.
[37] Kumar, R. L., Smith, M. A., & Bannerjee, S. (2004). User interface features influencing overall ease of use and personalization. *Information & Management, 41*(3), 289-302.
[38] Lee, Y. W., Strong, D. M., Kahn, B. K., & Wang, R. Y. (2002). AIMQ: a methodology for information quality assessment. *Information & Management, 40*(2), p133
[39] Lee, Y., Kozar, K. A., & Larsen, K. R. T. (2003a). The Technology Acceptance Model: Past, Present, and Future. *Communications of the AIS, 12*(50).
[40] Leung, H. K. N. (2001). Quality metrics for intranet applications. *Information & Management, 38*(3), 137-152.
[41] Li, S., & Lin, B. (2006). Accessing information sharing and information quality in supply chain management. *Decision Support Systems, 42*(3), 1641-1656.
[42] Liu, L., & Chi, L. (2002). Evolutional Data Quality: A Theory-Specific View. Proc. of the 7th International

Conference on Information Quality, (MIT IQ Conference) 2002, 292-304.
[43] Marchionini, G. (1995). Information Seeking in Electronic Environments. *Cambridge Series on human computer interaction, Cambridge: Cambridge University Press. 1995*.
[44] Marton, C. (2003). Quality of health information on the Web: user perceptions of relevance and reliability. *New Review of Information Behaviour Research, 4*(1), 195-206.
[45] Michnik, J., & Lo, M.-C. (2007). The assessment of the information quality with the aid of multiple criteria analysis. *European Journal of Operational Research, Article in Press, Corrected Proof, November 2007*.
[46] Moraga, Á., Calero, C., & Piattini, M. (2006). Comparing different quality models for portals. *Online Information Review, 30*(5), 555 - 568.
[47] Naumann, F., & Rolker, C. (2000). Assessment Methods for information quality Criteria. *Proc. of 5th International Conference on information quality*, 148-162.
[48] Neely, M. P. (2005). The Product Approach to Data Quality and Fitness for Use: A Framework for Analysis. *Proc. of 10th International Conference on Information Quality*.
[49] Nielsen, J. (1999). User Interface Directions for the Web. Communications of the ACM, 42(1), 65-72
[50] Palmquist, R. A. (1996). The search for an Internet metaphor: a comparison of literatures. *American Society of Information Science Conference*.
[51] Pernici, B., & Scannapieco, M. (2002). Data Quality in Web Information Systems. Proc. of ER-2002, 21st International Conference on Conceptual Modeling, Tampere, Finland.
[52] Prabha, C., Connaway, L. S., Olszewski, L., & Jenkins, L. R. (2007). What is enough? Satisficing information needs. *Journal of Documentation, 63*(1), 74 - 89.
[53] Price, R. & Shanks, G. (2004) A Semiotic Information Quality Framework, Proc. IFIP International Conference on Decision Support Systems (DSS2004): Decision Support in an Uncertain and Complex World, Prato, July
[54] Price, R., & Shanks, G. (2005). A semiotic information quality framework: development and comparative analysis. *Journal of Information Technology, 20*, 88-102.
[55] Rieh, S. Y. (2000). Information Quality and Cognitive Authority in the World Wide Web. *Dissertation Research at Rutgers University School of Communication, Information, and Library Studies* (Advisor: Nicholas J. Belkin).
[56] Savolainen, R., & Kari, J. (2006). User-defined relevance criteria in web searching. *Journal of Documentation, 62*(6), 685 - 707.
[57] Scannapieco, M., Pernici, B., & Pierce, E. (2002). IP-UML: Towards a Methodology for Quality Improvement based on the IP-MAP Framework. *Proc of the Seventh International Conference on Information Quality*
[58] Shankar, G., & Watts, S. (2003). A Relevant, Believable Approach for Data Quality Assessment. *Proc. of 8th International Conference on information quality*, 178-189.
[59] Shankaranarayan, G., Wang, R. Y., & Ziad, M. (2000). Modeling the Manufacture of an Information Product with IPMAP. *Proceedings of Conference on Information Quality, Massachusetts Institute of Technology*, 1-16.
[60] Shanks, G., & Corbitt, B. (1999). Understanding Data Quality: Social and Cultural Aspects. *Proc. 10th Australasian Conference on Information Systems*, 785-797.
[61] Song, J., & Zahedi, F. M. (2006). Trust in health infomediaries. *Decision Support Systems, 43*(2), 390-407.
[62] Spink, A., & Saracevic, T. (1998). Human-computer interaction in information retrieval: Nature and manifestations of feedback. *Interacting with Computers, 10*(3), 249-267.
[63] Strong, D. M., Lee, Y. W., & Wang, R. Y. (1997a). Data quality in context. *Communications of the ACM, 40*(5), p.103 - 110.
[64] Strong, D., Lee, Y., & Wang, R. (1997b). 10 Potholes in the Road to information quality. *IEEE Computer, 30*(8), 38-46.
[65] Sturges, P., & Griffin, A. (2003). The Archaeologist Undeceived: Selecting Quality Archaeological Information from the Internet. *Informing Science Journal, 6*, pp.221-232.
[66] Stvilia, B., Twidale, M. B., Smith, L. C., & Gasser, L. (2005). Assessing Information Quality of a Community-Based Encyclopedia. 10th International Conference on Information Quality
[67] Tayi, G. K., & Ballou, D. P. (1998). Examining data quality. *Communications of the ACM, 41*(2), 54 - 57.
[68] Taylor, R. S. (1982). Value-added processes in the information life cycle. *Journal of the American Society for Information Science, 33*(5), 341-346.
[69] Tombros, A., Ruthven, I., & Jose, J. M. (2003). Searchers‟ criteria For assessing web pages. Proc. 26th annual International ACM SIGIR Conference on Research and Development in Information Retrieval, Toronto, Canada, July 28 - Aug 01, 2003, p.385-386.

[70] Toms, E. G. (1997). Information Interaction: Providing a Framework for Information Architecture. *Journal of the American Society for Information Science & Technology, 53*(10), 855-862.
[71] Toms, E. G., O'Brien, H. L., Kopak, R., & Freund, L. (2005). *Searching for Relevance in the Relevance of Search*: In F. Crestani & I. Ruthven (Eds.): CoLIS 2005, LNCS 3507, pp.59–78.
[72] Vakkari, P., & Sormunen, E. (2004). The influence of relevance levels on the effectiveness of interactive information retrieval. *Journal of the American Society for Information Science and Technology, 55*(11), 963-969.
[73] Varlander, S. (2007). Online information quality in experiential consumption: An exploratory study. *Journal of Retailing and Consumer Services, 14*(5), 328-338.
[74] Wang, R. Y., & Strong, D. M. (1996). Beyond Accuracy: What Data Quality Means to Data Consumers. *Journal of Management Information Systems, 12*(4), 5-34. 27
[75] Whitmire, E. (2004). The relationship between undergraduates' epistemological beliefs, reflective judgment, and their information-seeking behavior. *Information Processing & Management, 40*(1), 97–111.
[76] Wu, M., Fuller, M., & Wilkinson, R. (2001). Using clustering and classification approaches in interactive retrieval. *Information Processing & Management, 37*(3), 459-484.
[77] Zeist, R. H. J., & Hendriks, P. R. H. (1996). Specifying software quality with the extended ISO model. *Software Quality Management IV - – Improving Quality*, pp.145-160.
[78] Zhu, X., & Gauch, S. (2000). Incorporating quality metrics in centralized/distributed information retrieval on the World Wide Web. *Proc. 23rd annual International ACM SIGIR Conference on Research and Development in Information Retrieval, Athens, Greece*, 288-295.

APPENDIX 1: TABLE OF 20 IQ MODELS (1996-2006)

Yr	Author	Model	Constructs/Components	
1996	Wang & Strong [74]	A Conceptual Framework for Data Quality *Summary:* » 4 Categories » 16 Dimensions	**Category**	**Dimensions**
			Intrinsic IQ	Accuracy, Objectivity, Believability, Reputation
			Accessibility IQ	Accessibility, Security
			Contextual IQ	Relevancy, Value-Added, Timeliness, Completeness, Amount of Info
			Representational IQ	Interpretability, Ease of Understanding, Concise Representation, Consistent Representation
	Zeist & Hendriks [77]	Extended ISO Model *Summary:* » 6 Quality characteristics » 32 Sub-characteristics	**Characteristics**	**Sub-characteristics**
			Functionality	Suitability, Accuracy, Interoperability, Compliance, Security, Traceability
			Reliability	Maturity, Recoverability, Availability, Degradability, Fault tolerance
			Efficiency	Time behaviour, Resource behaviour
			Usability	Understandability, Learnability, Operability, Luxury, Clarity, Helpfulness, Explicitness, Customisability, user-friendliness
			Maintainability	Analysability, Changeability, Stability, Testability, Manageability, Reusability
			Portability	Adaptability, Conformance, Replaceability, Installability
1997	Beck [6]	Evaluation Criteria for web information sources *Summary:* » 5 Criteria	**Criteria**	**Dimensions**
			Accuracy	reliable, error-free, verified
			Authority	attributed authorship, publisher - info origin
			Objectivity	free of bias, purpose of the web page
			Currency	last update, working hyperlinks
			Coverage	topics, depth of material, uniqueness of material
	Harris [23]	User-focused checklist (CARS) help researchers look for clues regarding website IQ *Summary:* » 4 contexts » at least 16 dimensions	**CARS (context)**	**Dimensions to be assessed**
			Credibility	trustworthy source, author's credentials, evidence of quality control, known or respected authority, organizational support.
			Accuracy	up to date, factual, detailed, exact, comprehensive, audience and purpose reflect intentions of completeness and accuracy
			Reasonableness	fair, balanced, objective, reasoned, no conflict of interest, absence of fallacies/slanted tone
			Support	listed sources, contact information, available corroboration, claims supported, documentation supplied
1999	Alexander & Tate [2]	Applying a Quality Framework to Web Environment *Summary:* » 6 Criteria	**Criteria**	**Dimensions**
			Authority	validated information, author is visible
			Accuracy	reliable, free of errors
			Objectivity	presented without personal biases
			Currency	content up-to-date
			Orientation	clear target audience
			Navigation	Intuitive design
	Katerattanakul & Siau [27]	IQ of Individual Web Site *Summary:* » 4 Quality Categories (adapted from Wang & Strong)	**Category**	**Dimension**
			Intrinsic IQ	Accuracy and errors of the content, Accurate, workable, and relevant hyperlinks
			Contextual IQ	Provision of author's information
			Representational IQ	Organisation, Visual settings, Typographical features, consistency, Vividness/attractiveness
			Accessibility IQ	Navigational tools provided

Table of 20 IQ Models (1996-2006) cont.

Yr	Author	Model	Constructs/Components
	Shanks & Corbitt [60]	Semiotic-based FW for Data Quality *Summary:* » 4 Semiotic descriptions » 4 goals of IQ » 11 dimensions	**Semiotic Level — Goal — Dimension** Syntactic — Consistent — Well-defined / formal syntax Semantic — Complete and Accurate — Comprehensive, Unambiguous, Meaningful, Correct Pragmatic — Usable and Useful — Timely, Concise, Easily Accessed, Reputable Social — Shared understanding of meaning — Understood, Awareness of Bias
2000	Dedeke [14]	Conceptual Framework for measuring IS Quality *Summary:* » 5 Quality Categories, » 28 dimensions	**Quality Category — Dimensions** Ergonomic Quality — Ease of Navigation, Conformability, Learnability, Visual signals, Audio signals Accessibility Quality — Technical access, System availability, Technical security, Data accessibility, Data sharing, Data convertibility Transactional Quality — Controllability, Error tolerance, Adaptability, System feedback, Efficiency, Responsiveness Contextual Quality — Value added, Relevancy, Timeliness, Completeness, Appropriate data Representation Quality — Interpretability, Consistency, Conciseness, Structure, Readability, Contrast
	Naumann & Rolker [47]	Classification of IQ Metadata Criteria *Summary:* » 3 Assessment Classes » 22 IQ Criterion	**Assessment Class — IQ Criterion** Subject Criteria — Believability, Concise representation, Interpretability, Relevancy, Reputation, Understandability, Value-Added Object Criteria — Completeness, Customer Support, Documentation, Objectivity, Price, Reliability, Security, Timeliness, Verifiability Process Criteria — Accuracy, Amount of data, Availability, Consistent representation, Latency, Response time
	Zhu & Gauch [78]	Quality metrics for information retrieval on the WWW *Summary:* » 6 Quality Metrics	**Assessment Class — IQ Criterion** currency — measured as the time stamp of the last modification of the document. availability — calculated as the number of broken links on a page divided by the total numbers of links it contains. info-to-noise ratio — computed as the total length of the tokens after pre-processing divided by the size of the document authority — based on the Yahoo Internet Life (YIL) reviews, which assigns a score ranging from 2 to 4 to a reviewed site. popularity — number of links pointing to a Web page, used to measure the popularity of the Web page cohesiveness — determined by how closely related the major topics in the Web page are
2001	Leung [40]	Adapted Extended ISO Model for Intranets *Summary:* » Adaptation of Zeist & Hendriks Model, applied to Intranet » Grey, italic sub-ch were considered *not needed* to achieve IQ	**Characteristics — Sub-characteristic** Functionality — *Suitability*, Accuracy, *Interoperability*, *Compliance*, Security, Traceability Reliability — Maturity, Fault tolerance, Recoverability, Availability, Degradability Usability — Understandability, Learnability, Operability, Luxury, Clarity, Helpfulness, Explicitness, user-friendliness, Customisability Efficiency — Time behaviour, Resource behaviour Maintainability — Analysability, Changeability, Stability, Testability Manageability, Reusability Portability — *Adaptability*, *Installability*, *Replaceability*, *Conformance*
2002	Kahn, Strong & Wang [26]	Mapping IQ dimension into the PSP/IQ Model *Summary:* » 2 Quality Types, » 4 IQ Classifications, » 16 IQ dimensions	**Quality Type — Classification — Dimension** Product Quality — Sound Information — Free-of-Error, Concise, Representation, Completeness, Consistent Representation Product Quality — Useful Information — Appropriate Amount, Relevancy, Understandability, Interpretability, Objectivity Service Quality — Dependable Information — Timeliness, Security Service Quality — Useable Information — Believability, Accessibility, Ease of Manipulation, Reputation, Value-Added
	Liu & Chi [42]	Evolutional Data Quality	**Quality Type — Dimension** Collection Quality — Accuracy, Objectivity, Trustworthiness, Completeness, Clarity Organisation Quality — Reliability, Consistency, Storage Efficiency, Retrieval Efficiency, Navigability Presentation Quality — Semantic Stability, Faithfulness, Neutrality, Interpretability, Formality Application Quality — Ease of Manipulation, Timeliness, Privacy, Security, Relevancy, Appropriate Amount of Data
	Eppler & Muenzenmayer [17]	Conceptual Framework for IQ for Website *Summary:* » 2 Manifestations, » 4 categories, 16 dims	**Quality Type — Categories — Dimension** Content Quality — Relevant Information — Comprehensive, Accurate, Clear, Applicable Content Quality — Sound Information — Concise, Consistent, Correct, *Current* Media Quality — Optimized Process — Convenient, *Timely*, Traceable, Interactive Media Quality — Reliable Infrastructure — Accessible, Secure, Maintainable, *Fast*
	Klein [30]	5 IQ Dimensions (chosen from Wang & Strong's 15 Dimensions)	**IQ Dimensions — Preliminary Factors** Accuracy — Discrepancy, Timeliness, Source/Author, Bias/Intentionally False Information Completeness — Lack of Depth, Technical Problems, Missing Desired Information, Incomplete When Compared with Other Sites, Lack of Breadth Relevance — Irrelevant Hits When Searching, Bias, Too Broad, Purpose of Web Site Timeliness — Information is Not Current, Technical Problems, Publication Date is Unknown Amount of Data — Too Much Information, Too Little Information, Information Unavailable
2003	Shankar & Watts [58]	Theoretical Model for Data Quality Assessment.	**IQ Dimensions — Preliminary Factors** Object — Accuracy, Completeness, Timeliness User — Believability, Relevance
	Sturges & Griffin [65] (much adapted from Smith,1997)	Tool for Archaeological website quality eval. *Summary:* » 5 contexts » 14 'named' dimensions (10-15 more implied)	**Criteria — Explanation** Scope — subject breadth - comprehensiveness | subject depth - appropriate for audience Purpose/Audience — consistency, appropriateness Content — accuracy, authority, copyright, currency, uniqueness, links, quality, and overall quality Graphic & Media Design — attractive, well organised, good quality illustrations, navigational aids Workability — user friendliness, computer environment, searching, browsability and organization, interactivity, connectivity

Table of 20 IQ Models (1996-2006) cont.

Yr	Author	Model	Constructs/Components		
2004	Tombros, Ruthven & Jose [69]	5 dimensions for judging quality in web pages The arrow ⇨ (right) is IQ part of the model	**Web Feature**	**Metric/Criterion**	
			Text	Content, Numbers, Titles/Headings, Query Terms, Text Quantity	
			Structure	Layout, Links, Links Quality, Table Layout	
			Quality ⇨	Scope/Depth, Authority/Source, Recency, General Quality, Content Novelty	
			Non-textual	Pictures	
			Physical Properties	Page Not Found, Page Location, Page Already Seen, Others	
2005	Stvilia, Twidale, Smith & Gasser [66]	Application of 7 known IQ metrics to automated system (evaluation) tool, to measure IQ of Wikipedia content	**Metrics**	**measured by automated tool**	**Related Dimensions**
			Authority/Reputation	by the *authors* of the material	Reliability
			Completeness	by broken hypertext links within articles	
			Complexity	by the readability of the content	Understandability
			Informativeness	by diversity of content	Value-Added
			Consistency	by number of non-unique authors	
			Currency	by how current (up-to-date) content is	
			Volatility	by time taken to fix erroneous content	Security, Believability
2006	Song & Zahedi [61]	IQ dimensions that influence users judgments of Web-based Health infomediaries	**Construct**	**Author's description**	**Related Dimensions**
			Adequacy	completeness, coverage (scope), and level of bias in information	Completeness, Coverage, Scope/Depth
			Relevance	practical (personal) applicability of information to individual user	Applicability
			Usefulness	(overall) perceived usefulness of information *[TAM of info not system]*	Accessibility & Availability
			Reliability	accuracy and credibility	Accuracy, Credibility
			Understandability	clarity and ease of comprehension – i.e.; accessibility of health jargon *[TAM of info, not system]*	Understandability
			Ease of Use	[TAM] ease of (system) navigation	Efficiency, Usability
			Interactivity	benevolence and personalisability	Value-Added,
			HI's Trust signs	policies & security, disclosures & ownership,	Objectivity, Security

APPENDIX 2: KNIGHT'S (2008) ADDITION TO IQ MODELS

Yr	Author	Model	Context	Info Action	Category	Dimensions
2008	Knight [33]	Combined Conceptual Life Cycle	↑	classification	Intrinsic IQ	Reliability, Objectivity, Accuracy, Believability
			Gen. ↓ ↑	Production	Representational IQ	Conciseness, Completeness, Consistency, Understandability
			Use	Retrieval	Interactional IQ	Accessibility, Usability, Efficiency, Security
			↓	Extraction	Contextual IQ	Currency, Uniqueness, Relevancy, Scope/Depth