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The next generation of the web: an organisational perspective

Fefie Dotsika

Westminster Business School

Westminster Business School, University of Westminster

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Fefie Dotsika

Westminster Business School

Corresponding author:

Fefie Dotsika
Westminster Business School
University of Westminster
35 Marylebone Road
London NW1 5LS, UK
F.E. Dotsika@westminster.ac.uk

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The next generation of the Web: an organisational perspective

Fefie Dotsika
Senior Lecturer
University of Westminster

Abstract:

The web has revolutionised information sharing, management, interoperability and knowledge discovery. The union of the two prominent web frameworks, Web 2.0 and the Semantic Web is often referred to as Web 3.0. This paper explores the basics behind the two paradigms, assesses their influence over organisational change and considers their effectiveness in supporting innovative solutions. It then outlines the challenges of combining the two web paradigms to form Web 3.0 and critically evaluates the impact that Web 3.0 will have on the social organisation. The research carried out follows action research principles and adopts an investigative and reviewing approach to the emerging trends and patterns that develop from the web's changing use, examining the underpinning enabling technologies that facilitate access, innovation and organisational change.

Keywords: *Knowledge management, web technologies, web information modelling, Web 3.0.*

1. Introduction

Web 2.0 is a user-centric web environment where information modelling is based on non-standardised user-generated folksonomies and innovation originates in social interaction. The Semantic Web is a machine-centric framework of web standards, semantic-driven, built top-down with formal classification schemes and highly searchable content. Information modelling is supported by a standardised, precise framework of XML, RDF and ontologies. Innovation is built on find-ability.

Both paradigms are based on the interlinking of information, way beyond the hypertext linkage that Web 1.0 introduced and web users took for granted. They both create information networks which are highly dynamic, interactive, adaptive and searchable. The Web 2.0 network is firmly based on the social aspect of its technologies. The Semantic Web network is the standardised principle of linked resources by means of Uniform Resource Identifiers (URIs), so that knowledge representation is web-embedded, with URIs assigned to terms and relationships. What would it be like joining the two?

Merging the power of the two network models, namely the social aspect with the standardised and interoperable information framework, leads to the new generation of web applications referred to as Web 3.0. Disregarding attempts to refer to the Semantic Web as Web 3.0 (Lassila & Hendler 200, Hendler 2008), in this paper we will use the term Web 3.0 to refer to the union of Web 2.0 and Semantic Web. While a fully functioning Web 3.0 is probably years away, there has been endless speculation about its impact.

In the early 80s Robert Metcalfe claimed that the value of a (telecommunications) network was proportional to the square of the number of users, despite the fact that its cost grew linearly with the number of connections (Gilder 1993). Metcalfe's heuristic has been cited, debated and replaced by alternatives many times since (Reed 2003; Brisco et. al 2006; Hendler & Golbeck 2008). The phenomenon is referred to as the *network effect* and, despite the lack of definitive algorithm consensus and hard mathematical proof, it is still part of web network analysis and provides an indication of the impact the merging of the two paradigms will have.

Semantic technologies coupled with social networking can instigate innovative influence with wide organisational implications that can benefit a considerable range of industries. The scalable and sustainable business models of social computing and the collective intelligence of organisational social media can be resourcefully paired with internal research and knowledge from interoperable information repositories, accounting systems, back-end databases etc. Web 3.0 can free human resources so that they can be used to better serve business development, support innovation and increase productivity.

Examples of Web 3.0 applications have appeared in various areas, such as medicine and bioinformatics (Giustini, 2007, Mesco 2007) the travel industry (Gruber 2007), publishing (Shaw 2010) and, of course education (Ohler 2008).

Since Web 3.0 is a combination of Web 2.0 and the Semantic Web, supporting and enhancing the applications with considerable organisational impact, we start by re-visiting the two well-known architectures and build on our findings. The rest of the paper is organised as follows: in section 2 we give a comprehensive overview of Web 2.0 and its use and role in today's organisation and Enterprise 2.0, from basic technologies and tools to innovation potential. Section 3 sums up the Semantic Web architecture and examines information modelling issues, challenges and its impact within the social organisation. In section 4 we look into integration and we investigate tools for automation, quality issues and obstacles. Section 5 focuses on Web 3.0's organisational impact and section 6 presents our conclusions.

2. The user aspect: Web 2.0

Web 2.0 (O'Reilly 2005) was coined in 2005 by Tim O'Reilly and is a selection of technologies and applications rather than an architecture. Web 2.0 focuses on social interaction, end-user involvement and information sharing. The content is user-generated and the information modelling is informal, carried out bottom-up by means of user-generated tag systems. Data and information are seen as the driving forces. Paired with the relevant business practices, Web 2.0 gave birth to Enterprise 2.0, a term that describes the set of Web 2.0 technologies enabling access to collective intelligence within organisations. These core technologies enable innovation through websites/sources of collective content with functionality that gets enriched as more people use them. There are different ways to partition Web 2.0 technologies in order to examine their functionality, organisational impact and effectiveness in supporting innovation. The scope of the paper suggests that we follow the life-cycle of Web 2.0 content, from creation, distribution and re-use to its role as a vehicle of social interaction and then through to retrieval and deployment.

Compared to the traditional static web pages, Web 2.0 content can be dynamically generated by means of blogs, wikis, Ajax applications and RSS feeds. Organisational blogs are particularly widespread in both the private and public sectors (Kim et al 2008) and have a considerable effect on employee engagement, communication and collaboration. Integrated tools that combine data from more than one sources called *mashups* are used as situational applications that solve immediate business problems (Jhingran, 2006). Rigid content management systems are successfully aided or even replaced by collaborative wikis (Melhrose et al 2009). Information sharing and syndication are enabled by aggregators and RSS feeds, a widely adopted family of formats used to publish frequently updated content that improves organisational communication by streamlining smart information within employees' communities of practice, on their desktops, mobile devices or through their email clients.

The heart of Web 2.0 is social. The word "social" is used to form numerous compound terms such as social- computing, media, software and networks. Social computing has transformed digital economics with business models that are scalable, have low barriers for entry and are sustainable in the long term. Harnessing the power of social computing has created the need for organisational strategies that reflect the shift in online culture (Shuen 2008, Li & Bernoff 2008). The social organisation can be enclosed within the firewall when social interaction is limited to organisational networking and in-house communities of practice, or can tap into the rest of the web and maximise its use of collective intelligence. In the case of organisations with digital presence, user interactions in social networks, paired with effective communication govern the revenue models. Increasing the member base becomes crucial when the revenue model is advertising, willingness to pay is the prominent driver for a subscription model and trust is of paramount importance for revenue based on transactions (Enders et al 2008).

Web 2.0 information modelling is done by means of user-generated tags known as folksonomies (Smith 2008). Folksonomies are collaborative metadata, created bottom-up in an analytical synthetic way. They are successful in organising corporate (Patrick & Dotsika 2007) information and enable innovation (Hayman 2007). Information find-ability and organisational visibility are further improved by search engine optimization (SEO). SEO replaced the trend of acquiring Internet domain names relevant to the nature of the business carried out and ended the lucrative domain name speculation of the 90s.

Web 2.0 technologies gave marketing a great boost. Apart from Enterprise 2.0 and SEO-based marketing, there are a number of other methods that have evolved in parallel. With trend forecasting, marketing specialists look into web searches and keyword databases for sophisticated and accurate market predictions (Rangaswamy et al 2009). With web analytics, the analysis of a set of metrics provides information about website traffic and can be used in business research. In social media marketing, social networks are exploited to increase brand awareness, promote customer interaction, facilitate monitoring and achieve marketing objectives.

Web 2.0 deploys web services which are applications requested and executed remotely and which interface with one another providing a standard means of interoperating between different software applications. Web services share business logic, data and processes and promote interoperability and re-use. Web services' composition creates business processes and complex workflows and is regulated by standards such as *orchestration* and *choreography* (Busi et al, 2006). Adoption of web services is on the increase due to the fact that organisations associate competitive advantage with a process of ongoing adaptation through flexible business processes and web services are proven to be a key determinant on business process flexibility (Deependra & Jay 2005). Large organisations are not the only ones to benefit. Use of web services by small and medium enterprises (SMEs) can improve agility and deliver strategic benefits such as higher profit margins and better competitive positioning (Ray & Ray, 2006).

The table below expands the customary comparative analysis between Web 1.0 and Web 2.0, to include assisting technologies and ensuing organisational applications. The third column (Web 2.0) consists of the additional features that are thought of as Web 2.0, but also assumes the contents of the second column, that is the attributes, technologies and methods associated with Web 1.0. The final column of organisational innovation examples contains a small sample of relevant applications and is suggestive rather than exhaustive.

	Attribute	**Web 1.0**	**Web 2.0 (Web 1.0+)**	**Web 2.0 assisting technologies**	**Organisational innovation & Enterprise 2.0**

Content generation, distribution and re-use.	**Content nature**	Static	Dynamically generated pages	Blog publishing tools, AJAX	Organisational blogs, dynamic websites.
			Mash-ups	Mash-able APIs such as GoogleMaps, eBay, Amazon, Yahoo Traffic	Business, enterprise and advertising mashups.
	Content management	Content Management Systems	Wikis	Wiki technologies such as Mediawiki	Organisational wikis, Wikipedia
	Content manipulation and sharing	Screen/Web scraping, hyperlinks	Data and media sharing, syndication	Content aggregators, XML-based feeds	Adoption/use of RSS feeds
Social interaction	**Social interaction/ communication**	Websites & their visitors. Newsgroups & bulletin boards.	Social computing, social media	Social networking, virtual communities, online auctions, reputation systems, prediction markets.	Specialist groups (LinkedIn, Facebook etc.) Organisational social networks
Retrieval and deployment	**Information modelling**	HTML/XHTML	User tagging	Folksonomies	Organisational tag clouds, use of flickr, Del.icio.us, technorati, etc.
	Find-ability	Domain name speculation	Enhanced search algorithms	Search engine optimisation (SEO)	Search Engine Marketing (SEM), user profiles, targeted, social and viral marketing
	Marketing	Advertisements	Social media-based marketing	SEO, cookies, RSS, Web analytics.	
	Deployment	Websites	Web as a platform	Web Services	Amazon Web Services, Google Apps, etc.

Table 1. Web 2.0 technologies and tools

There are problems with Web 2.0, just like there are problems with everything that has participation and collaboration at its core (Ebner et al 2007, Vickery & Wunsch-Vincent 2007). Quality of information is at the centre of the disadvantages cited about Web 2.0 (Antiqueira et al 2007). Information modelling with folksonomies presents a number of further quality issues (Dotsika 2009). Other organisation-centred problems include technology dependence, security concerns, information overload and difficulties in finding relevant context. Ethical and legal issues such as privacy, anonymity, reputation, intellectual property rights, copyright violations, monetary function and trust are other often-quoted concerns. On the web services front, adoption is affected by low performance, basic forms of service invocation and service discovery issues (Wang et al 2004). While business adoption increases, organisations are reluctant to establish service registries, repositories and service level objectives.

3. The technology aspect: Semantic Web.

Tim Berners-Lee introduced the *Semantic Web* (SW) in 2001 (Berners-Lee 2001) as a form of web content where knowledge representation is standardised and relies on languages expressing information in a machine process-able form, by means of a framework based on RDF (Resource Description Framework) and ontologies. The information modelling is predominantly top-down and it is done formally, without the participation of end-users.

The organisational impact of the Semantic Web is based on system interoperability and adaptive, personalised information access. Interoperability addresses heterogeneity issues present in data and business processes and it ensures information integration across systems, a process too costly for any organisation. Interchange, distribution and creative reuse are a Semantic Web inherited standard, while scalability is dependent upon increasingly powerful implementations (Ankolekar et al, 2007). Adaptive technologies facilitate the tailoring of information access according to given user profiles. Intelligent information integration and agents such as information brokers, filters, personalised search agents and Knowledge Management Systems (KMS) are examples of innovative applications. Public sector adoption of web-based integrated KMS has overcome earlier challenges and the designated systems have proven their ability to support knowledge work and deliver strategic change (Butler et al, 2008).

The SW framework consists of XHTML, XML, the Resource Description Framework (RDF), a range of data interchange formats and notations and the Web Ontology Language (OWL).

On the semantic annotation front, XHTML supports *microformats*, a method that uses existing XHTML (or HTML) tags to semantically annotate web data (Allsop 2007). Their application is currently centred in the annotation of certain information such as contact details (hCard) and events (hCalendar) etc. The simplicity of microformats has made their adoption popular.

The Resource Description Framework (Beckett 2004) is an XML-based, standardised semantic annotation method, and, as such, interoperable. RDF modelling is done by means of subject-predicate-object expressions, known as *triples.* The RDF Schema (RDFS) adds basic ontology description power to plain RDF and many of its components are included in OWL. Together with RDF they form Semantic Web's RDF layer which adds semantics to web content and enhances machine process-ability. The model is scalable and searches are improved as the information can be processed in relation to the modelled relationships between data and/or resources. SPARQL is an RDF query language, part of the Semantic Web framework (WC3 2008A).

A number of "easier" interchange formats have been also used instead of RDF/XML. No major applications of these formats are currently adopted widely by organisations but they are briefly reviewed in the interest of completeness. RDFa is a specification of the W3C (Adida & Birkbeck 2008) and represents a simpler alternative to RDF that allows XHTML documents to be marked-up and allows the import of area specific vocabularies. Notation 3 (Berners-Lee, 1998) is a simpler, not XML-based, more readable version of RDF. Turtle (Terse RDF Triple Language) is a serialisation format for RDF graphs and a subset of N3. N-Triples (W3C 2001) is a line-based, plain text format for RDF graphs and a subset of Turtle.

The top part of the SW framework are ontologies, sets of shared, explicit and formal concepts used to organise and classify content. From an organisational point of view, ontologies are used to model enterprise information and processes accurately and consistently, enabling automatic reasoning, concept-based searches, process composition and knowledge discovery by means of intelligent agents (Hendler 2001). The Web Ontology Language OWL (Smith et al 2004) is a family of languages built using XML/RDF syntax and part of the Semantic Web framework.

Table 2 summarises the role, functionality and applications of Semantic Web technologies. Unlike Table 1, the focus here is the technologies supporting the content, rather than the content itself. The shaded part signifies technologies also used by Web 2.0.

	Assisting Technology	**Role**	**Functionality**	**Support**	**Application**	**Innovation/ applications with organisational**

						implications
Display	**HTML**	Data displaying mark-up	Web 1.0 content	Web browser	Web pages	
	XHTML	Data displaying mark-up XML-compatible	Web 2.0 content	Microformats	hCard, hCalendar, hNews etc.	XHTML Friends Network (XFN)
Syntax and Semantics	**XML**	Data describing mark-up	Modelling of data, data structures	Ajax, Data Object Model (DOM), Java applications, Web APIs	Dynamically updated web pages, web services	Web services supporting technologies and languages such as UDDI, WSDL, BPEL, etc.
	RDF, RDFa	XML-based semantics	Modelling information about resources	Data interchange, machine processing, increased findability	Semantic search, system interoperability, information remix and reuse, semantic mashups, etc.	RSS, AlchemyAPI, Wikipedia[3], etc.
	N3, Turtle, NTriples	Non-XML based semantics				Search-engine adoption, (Search-monkey), use in SEO, Wapedia, etc.
Rules and inference	**RDFS**	RDF + basic vocabulary	Modelling class hierarchies & properties	Intelligent agents, personalisation, adaptive information access	Natural language search engines, dynamic and adaptive contextual information builders, information brokers and filters, personalised search agents, intelligent adaptive social media, etc.	FOAF, SIMILE, OpenPSI, etc.
	OWL	Reasoning power	Modelling of rules and constraints			

Table 2. Functionality and application of Semantic Web technologies.

The problems with the Semantic Web are mostly of a technical nature and come as a consequence of the complexity that is associated with its technologies.

RDF is difficult to publish. Web content annotated with RDF requires XHTML for its textual presentation but also a parallel RDF/XML part to publish the semantic information. Any development of RDF/RDFS or OWL requires specialised expertise and this has prevented widespread adoption. Its formality makes it difficult to master and limits its popularity.

Scalability is another concern. Once we take the Semantic Web applications outside the relatively few semantically annotated sites, it becomes apparent that the size of the web and the sheer amount of data it contains present a challenge. The creation of common ontologies and the mass transition to semantic annotation are more than a few years off.

When large ontologies are created, their quality can be an issue. The main problem is semantic uncertainty, which can be divided into ambiguity, randomness, inconsistency, incompleteness and vagueness (W3C 2008B). Handling semantic uncertainty plays an important role in ontology languages for the Semantic Web.

All this makes organisational adoption expensive and cumbersome. While large companies and high budget projects embrace the Semantic Web readily in order to take better advantage of intellectual assets, enhance productivity and increase competitiveness, smaller companies with web presence have remained reluctant to do the same.

4. Web 2.0 and Semantic Web integration.

The advantages of merging the Web 2.0 technologies with the Semantic Web infrastructure are obvious. But what exactly are the practicalities involved? And how can organisations achieve such transition? There are three different approaches for reconciling Web 2.0 and the Semantic Web.

The first is the obvious, “straightforward” method: start from scratch and create web resources which follow the standards of the Semantic Web platform before end-users are allowed to add their (probably somewhat restricted) bottom-up markup and collaborative tagging. Organisational or off-the-shelf ontologies might be used and interoperability will be ensured. However, this is a scenario that aligns almost exactly with the creation of Semantic Web pages and applications, and therefore it is not addressed at this stage. Instead, we will concentrate on the two other existing methods of integration: the transformation of folksonomies into ontologies and the use of semantic APIs.

4.1. Transforming folksonomies into ontologies

This approach makes use of the richness of Web 2.0 by retaining the flexibility, collaboration and information aggregation of existing folksonomies and transforming them into ontologies. There are a number of methods that follow this route. The most popular/known are:

- The creation of *FolksOntologies* (Van Damme et al. 2007) is a method that derives ontologies from folksonomies analysing the latter and their associated data to determine relations, complements the output with online lexical resources and employs ontology mapping techniques where conceptual elements can be matched based on the labels, ontology structure or both.

- Another method makes explicit the semantics behind the folksonomy tag space (Specia & Motta 2007) and integrates folksonomies with the Semantic Web by employing occurrence analysis and clustering techniques.

- Deriving semantics from folksonomies can be done by statistically analysing the tags and creating a *tag cloud* (i.e. a set of related tags depicted in different font sizes and colours according to their weight/cardinality) (Lux & Dosinger 2007). By means of computing the tags co-occurrence, the cloud is transformed into a weighted, directed *network of tags* which in turn is used to create an ontology.

- Another approach is to capture latent emotional semantics in social tagging systems (Baldoni et al. 2008) by means of adding a semantic layer to the social tagging of *Arsmeteo*, a web portal for sharing works of art containing a folksonomy of over 10,000 tags. These tags are related to *OntoEmotions*, an OWL ontology chosen for fitting the application purposes.

All the above methods share common problems with quality assurance, mapping efficiency and ethical issues.

Quality issues are present in both folksonomies and ontologies. In folksonomies the problems are ambiguity (polysemes and homonyms), inexactness (synonyms), granularity discrepancies (Golder & Huberman 2005) and, of course, misspellings and inaccuracies. Ontologies suffer from issues of completeness, transformation rules, domain expertise, structural and atomic qualities (Colomb & Weber 1998; Rector et al. 2001; Kashyap 2003).

When it comes to information mapping, the existing methods are inefficient in mapping certain additional information contained in tags that semantically corresponds to attributes and/or properties. A further problem is the possible absence of a relevant ontology so that special tags cannot be adequately mapped.

In the area of ethics, transforming folksonomies to ontologies requires to harvest information from several systems, a process that implies a level of trust and raises a certain level of ethical questions.

In order to alleviate these problems and regulate the process, an integration framework has been proposed (Dotsika 2009). The framework identifies the existing shortcomings, groups them according to the integration requirements and suggests four steps that can be followed to regulate the transformation: (a) quality assurance, (b) semantic enrichment, (c) mapping completeness and (d) issues of trust and ethics.

From an organisational point of view, the main advantages of the above methods of integration are the preservation of the organically grown tag systems and the safeguarding of the bottom-up design, collective intelligence assets and end-user involvement. However, the alignment of folksonomies is not an inexpensive operation, especially since the methods presented are only partially automated and therefore need to be tailored to specific organisational requirements.

4.2. Semantic APIs

This method adds semantics to existing web content automatically, by means of specialist *semantic* Applications Programmers Interfaces (APIs) which take unstructured text input and return the content's contextual framework. There are a number of semantic APIs available, offering a variety of options and flexibility. The best known are:

- The Dapper (Data Mapper) API (Dapper, 2005) enables developers to extract semantics from web content in the form of an XML document that can then be used to build mashups, RSS feeds and other applications. The Dapper Semantify web service allows the user to define the content of interest, reads the website and creates a feed of the specific content.

- OpenCalais (Calais, 2008) is an automatic generator of semantic metadata in RDF format from web content, based on natural language processing (NLP). It works on text only and operates as a web service. The API reads in unstructured documents, recognises a number of different entities and annotates them semantically.

- SemanticHacker (SemanticHacker, 2008) is an API that takes text as input and classifies the document content into categories. The classification is done by identifying and returning a number of entities from a given classification scheme (the Open Directory Project). Their weight is then measured and a relevance score returned. The system employs NLP and text mining techniques.

- The Semantic Cloud service (Semantic Cloud API, 2009) identifies and extracts semantics from a web page or a document, creates a semantic cloud of concepts and generates a list. As an alternative it can take a set of URLs as input and return a multi-document summary about the main concepts present and/or an essay on a specific topic.

- The Zemanta API (Zemanta 2009) takes in unstructured text and returns tags, categories, links, photos, and related articles. The service acts as a single-point entry to various, pre-indexed, content databases. Zemanta analyses the postings, discovers relevant content and adds it to the page or document. The system uses NLP and semantic algorithms and categorises content by comparing it to their pre-indexed database.

- The Ontos API Semantic web service (Ontos 2009) provides the means to personalise the NLP platform that returns named entities and semantic relations when fed with non-semantically annotated text. Users can define their own semantic content via external dictionaries and can tune concepts from core ontologies. Ontos supports visual representations in the form of cognitive maps, dynamic reports and summaries from document collections.

There have been studies to evaluate and compare the various systems in order to inform and steer organisational adoption (Dotsika 2010; DiCiuccio 2010). Due to the disparity of the products and the inconsistencies in the way the semantic APIs annotate web content, the evaluation is generally troublesome. The comparisons take into account performance and other basic product information, requirement-based decision planning and information modelling capabilities, and, in terms of classification schemes adopted, input sources and output formats.

All products identify key concepts and categories but depending on the original input, disambiguation issues and low entity-return seem to affect most APIs. The majority provide extra tools and plugins to customise results. Apart from the APIs own taxonomies, they allow custom taxonomies to be used as input and support a variety of output formats. Overall however, while the performance is not a problem, content annotation is fairly dependent upon the original content.

From an organisational point of view, the semantic APIs are the cheapest method of integration available. Since the design is top-down, the preservation of user-generated tags is problematic. The quality of the end product is also an issue, though most APIs allow for custom taxonomies which can theoretically improve the quality of the semantic tagging and, depending on the application, more than one semantic APIs can be used. Nevertheless, a lack of case studies of official adoption means that a fuller evaluation is not yet possible. The table below summarises our results and compares the different methods of integration.

	Folks→ Ontos	**SemAPIs**	**Ab initio**
Design	bottom-up	top-down	top-down
End user involvement	✓✓	✓	×
Folksonomy ⇔ ontology mapping	✓	×	possible
Information loss avoidance	limited	limited	✓
Flexibility – customisation	limited	possible	according to spec
Attributes/ complex tags	×	×	✓
Automation	partial (some methods)	✓✓	✓
Cost	££	£	£££
Evaluation/metrics/results	×	some	some

Table 3. Integration methods

5. The organisational implications of Web 3.0.

One of the main practical implications of Web 3.0 is the quality of information attained, as it has a direct impact on organisational success and profitability. Gathering the above facts we adopt the four-category quality model (Wang et al 1997; Zhu & Wang 2010) to create the comparative analysis table for web information quality. The focus is on organisational information rather than individual data. The first group of dimensions (*accuracy, objectivity* and *reliability*) are inherent qualities and therefore their values are, strictly speaking, unknown. However, the Semantic Web provides a logical, if weak, guarantee of quality control, due to the high cost of its application. Web 2.0 reputation systems can be deployed to enable reputation quality. The next group addresses contextual quality and is dependent on the nature of the task to be performed. While Web 2.0 technologies offer the potential to enhance all related dimensions (*relevancy, value-added, timeliness, completeness* and *volume*), it is the Semantic Web and Web 3.0 that provide the means for actual improvement. The categories of accessibility and representational quality focus on the employed infrastructure and are compared accordingly. Attributes such as *ease of understanding* and *concise representation* for instance score the same, although the underlying enabling technologies are different and therefore cannot be thought of as interchangeable. Security assessment is “naive” and does not involve particular web service security, data storage and information leakage issues. Table 4 bellow shows our findings.

Category	Dimension	Web 1.0	Web 2.0	SW	Web 3.0 [inherits from Web 2.0 & SW]
Intrinsic Data Quality	Accuracy	?	weak control	possible	improved
	Objectivity	?	weak control	possible	improved
	Believability	?	weak control	possible	improved
	Reputation	?	control mechanisms available	possible	control mechanisms available
Contextual Data Quality	Relevancy	?	improved	✓✓✓	✓✓✓
	Value-Added	×	improved	✓✓✓	✓✓✓
	Timeliness	?	improved	✓✓	✓✓✓
	Completeness	×	improved	✓✓	✓✓✓
	Amount of Data	?	improved	✓✓	✓✓✓
Accessibility	Accessibility	✓	✓✓	✓✓✓	✓✓✓
	Access Security	✓	✓✓	✓✓	✓✓
Representation	Interpretation	✓	✓✓	✓✓✓	✓✓✓
	Ease of Understanding	✓	✓✓✓	✓✓✓	✓✓✓
	Concise Representation	✓	✓✓✓	✓✓✓	✓✓✓
	Consistent Representation	✓	✓✓	✓✓✓	✓✓✓

Table 4. Web information quality

The next step is to sum up the information gathered about other aspects of significant impact from an organisational point of view and create a second table for reference and comparison. For consistency we maintain the facets we identified in section 2, focused on content generation, distribution, retrieval and deployment. Content generation is the category that stands out in terms of enhanced performance. The result is not a surprise as Web 3.0's main strengths are personalisation, custom and on-demand content. Distribution does not fare any different to previous web frameworks and there is no evidence that content search would improve that of the Semantic Web. Advanced automation enables networking to be content- as well as consumer-directed. The scalability and tractability attributed to Web 2.0 are not that clear in Semantic Web environments and they have been deliberately left undefined. Table 5 presents the results of the analysis.

	Organisational aspect	Web 1.0	Web 2.0	SW	Web 3.0
Content generation, distribution and reuse	Seamless, on-demand content	×	✓✓	✓✓	✓✓✓
	Info analysis: Personalisation - tailoring	×	✓	✓✓	✓✓✓
	Info synthesis: Custom mashups	×	✓	✓	✓✓✓
	Interchange, distribution, creative reuse	×	✓✓	✓✓	✓✓
	Ownership	individual	shared	either	either
Social aspect	Networking	×	content-directed	content-directed	content- or consumer-directed
Content retrieval and deployment	Search	✓	✓✓	✓✓✓	✓✓✓
	Scalability - tractability	×	✓	?	?
	Web services – cloud computing	×	✓	✓✓	✓✓
	Media-centric capabilities	×	×	limited	limited

Table 5. Web 3.0 benefits for the enterprise

6. Conclusions and discussion.

This paper addresses the impact and implications of Web 3.0 from an organisational perspective. Having defined Web 3.0 as the integration of Web 2.0 and the Semantic Web, the research carried out investigated the parent web frameworks as a first step and recorded their distinctive capabilities in order to set the base for comparative analysis and impact assessment for the new generation of web technologies.

Automated means of migration to Web 3.0 and organisational adoption were explored. The methods for transforming folksonomies into ontologies were deemed disappointing in terms of automation and derived information quality. However these methods safeguard bottom-up design and entail the highest end-user involvement. The alternative methods of semantic APIs provide a fully automated solution and are the cheapest. Their top-down design however limits end-user involvement. While waiting for the semantic APIs to evolve, deriving Web 3.0 web resources from scratch is presumed to be the best method. Nonetheless, the skills' level required and overall cost, make mass-adoption of this method a theoretical rather than practical approach.

Information quality was evaluated by means of a comparative analysis table based on information quality aspects. Apart from intrinsic data quality, where effects were mostly speculated at, the Web 3.0 framework yields the best results. Contextual data quality, accessibility and representation fared better than, or as well as, the best other category.

Web 3.0 contributed equally positively in all aspects addressing organisational content generation, distribution, retrieval and reuse. The content-directed networking of previous web generations is maintained and supplemented with the consumer-directed choice. Deployment of web services and cloud computing remain the major promoters of scalability and sustainability, despite their unassuming presence in the matrix.

There is enough evidence to suggest that the next web generation will be a hybrid mix of Web 2.0 technologies reinforced with semantic markup. Whether this markup will be the formal, robust variety of the Semantic Web or an automated, user-friendly approach, easier to implement and therefore better suited for organisational adoption, is yet to be seen. An obvious stepping stone towards this direction is the use of semantic APIs. Their continuing evolution requires further investigation and their detailed assessment and evaluation is part of our future research. Another aspect is the investigation of how the different web generations influence organisational change and sustainability. This one is also part of future research.

References

Adida B., Birkbeck M. (2008) [online], RDFa Primer, Bridging the Human and Data Webs, http://www.w3.org/TR/xhtml-rdfa-primer/ accessed 24 July 2010

Allsop J. (2007), Microformats: Empowering Your Markup for Web 2.0, Friends of Ed, NY

Anderson, Chris (2006), The Long Tail: Why the Future of Business Is Selling Less of More. New York: Hyperion. ISBN 1-4013-0237-8

A. Ankolekar, M. Krötzsch, T. Tran and D. Vrandecic, (2007), The Two Cultures, Mashing up Web 2.0 and the Semantic Web, *Proceedings of the 16th International Conference on World Wide Web* Banff, Alberta, Canada (May 2007), pp. 825–834.

Antiqueira, L.; Graças, M.; Nunesm V.; Oliveira O. N.; Da F. Costa, L. (2007), "Strong correlations between text quality and complex networks features*" Physica. A*, 373, 2007. pp. 811-820

Baldoni, M., Baroglio, C., Horváth, A., Patti, V., Portis, F., Avilia, M., and Grillo, P., Folksonomies meet ontologies in ARSMETEO: from social descriptions of artifacts to emotional concepts, In *Proc*. of Formal Ontologies Meet Industry (FOMI 2008*)*, Torino, Italy, June 2008

Beckett D. (ed) (2004) [online] RDF/XML Syntax Specification, http://www.w3.org/TR/rdf-syntax-grammar/ , accessed 24 July 2010

Berners-Lee T., (1998) Notation 3 Specification, (online) http://www.w3.org/DesignIssues/Notation3.html , accessed 24 July 2010

Berners-Lee T., Hendler J., Lassila O. (2001), The Semantic Web, Scientific American, May 2001

Briscoe, B., Andrew Odlyzko, and Benjamin Tilly. 2006. Metcalfe's Law is Wrong., IEEE Spectrum, July 2006

N. Busi, R. Gorrieri, C. Guidi, R. Lucchi, and G. Zavattaro. Choreography and orchestration conformance for system design. In *COORDINATION*, volume 4038 of *LNCS*, pages 63.81, 2006.

Butler, T., Feller, J., Pope, A., Emerson, B., Murphy, C., (2008), Designing a core IT artefact for Knowledge Management Systems using participatory action research in a government and a non-government organisation The Journal of Strategic Information Systems , Volume 17 Issue 4, December 2008

Calais, (2008) [online], http://www.opencalais.com/ accessed 24 July 2010

Cao,G., Clarke, S., Lehaney, B (2000), Towards systemic management of diversity in organisational change", Strategic Management, Vol. 8 No. 4, pp. 205-16.

Colomb R.M. and Weber R. 1998, Proceedings of the *International Conference on Formal Ontology in Information Systems* (FOIS'98) Trento, Italy, 6-8 June, 1998. In N. Guarino (ed.) *Formal Ontology in Information Systems* IOS-Press (Amsterdam) pp. 207-217

Dapper, (2005), [online] http://www.dapper.net/ accessed 24 July 2010

Deependra Moitra , Jai Ganesh, Web services and flexible business processes: towards the adaptive enterprise, Information and Management, v.42 n.7, p.921-933, October 2005

Dotsika, F., (2009) *Uniting formal and informal descriptive power: Reconciling ontologies with folksonomies*, International Journal of Information Management, Volume 29, Issue 5, October 2009, pp 407-415,

Dotsika, F., (2010) *Semantic APIs: scaling up towards the Semantic Web*, International Journal of Information Management, Volume 30, Issue 4, August 2010, pp 335-342

Ebner, M., Holzinger, A. & Maurer, H. (2007) Web 2.0 Technology: future interfaces for technology enhanced learning? *Lecture Notes in Computer Science*, 4556, 559-568.

Enders, A., Hungenberg, H., Denker, H., Mauch, S., (2008), The Long Tail of Social Networking: Revenue Models of Social Networking Sites, European Management Journal, Volume 26 (3), June 2008, p. 199-211. 8 15.579

Garrett, J. (2005) [online], Ajax: A New Approach to Web Applications. Adaptive Path website, http://www.adaptivepath.com/publications/essays/archives/000385.php accessed 24 July 2010 , accessed 24 July 2010.

Gilder, G., (1993), Metcalf's Law and Legacy, Forbes ASAP

Giustini, D., (2007), Web 3.0 and Medicine, British Medical Journal, 335(7633), December 2007, pp 1273-1274

Golder, S., and Huberman, B.A., 2005, [Online], The Structure of Collaborative Tagging Systems. HP Labs technical report, http://www.hpl.hp.com/research/idl/papers/tags/

Gruber, T., (2006) Where the Social Web meets the Semantic Web, 5th International Semantic Web Conference, November 7, 2006

Hayman, Sarah (2007), Folksonomies and Tagging, New Developments in Social Bookmarking, Ark Group Conference: Developing and Improving Classification Schemes, Sydney June 2007

Hendler, J. (2001) Agents and the semantic web. IEEE Intelligent Systems, 16(2). pp. 30-37

Hendler, J., (2008), " Web 3.0: Chicken Farms on the Semantic Web" *Computer*, 41 (1), 2008, pp.106-108

Hendler, J., Golbeck, J., (2008) Metcalfe's law, Web 2.0, and the Semantic Web, Web Semantics: Science, Services and Agents on the World Wide Web, v.6 n.1, p.14-20, February, 2008

Jhingran, A., (2006), Enterprise information mashups: integrating information, simply, Proceedings of the 32nd international conference on Very Large Data Bases, Seoul, Korea 2006

Johnson, D., (2005) [online], AJAX: Dawn of a new developer: The latest tools and technologies for AJAX developers. JavaWorld.com, http://www.javaworld.com/javaworld/jw-10-2005/jw-1017-ajax.html , accessed 24 July 2010.

Jones, C., R. Hecker and P. Holland (2003), 'Small Firm Internet Adoption: Opportunities Foregone, a Journey Not Begun', *Journal of Small Business and Enterprise Development* 10, 3, 287–297.

Kashyap V. 2003,*Trust and quality for Information Integration: The Data-Metadata-Ontology Continuum*, Workshop on Data Quality, Dagstuhl, Germany, September 2003

Kim, J., Lee, SH., Shin, M. S., (2008), Current usage of organisational blogs in the public sector, International Journal of Information Technology and Management 2008 - Vol. 7, No.2 pp. 201 - 216

Lassila O., Hendler, J., (2007), Embracing Web 3.0. Internet Computing, IEEE, 11(3):90-93, 2007.

Li, Charlene; Bernoff, Josh (2008). Groundswell: Winning in a World Transformed by Social Technologies. Boston: Harvard Business Press

Lux, M., Dosinger, G. (2007), From folksonomies to ontologies: employing wisdom of the crowds to serve learning purposes International, International Journal of Learning Technology, Volume 3, No 4/5, pp. 515-528

Meloche, J. A., Hasan, H. M., Willis, D., Pfaff, C. & Qi, Y. (2009). Co-creating Corporate Knowledge with a Wiki. International Journal of Knowledge Management, 5 (2), 33-50.

Mesko B. (2007), [online], Web 3.0 and medicine. ScienceRoll blog, http://scienceroll.com/2007/04/06/web-30-and-medicine/, accessed 28 July 2010

Ohler, J., (2008), The Semantic Web in Education, *Educause Quarterly,* vol. 31, no. 4, 2008

Ontos, (2009) [online], http://www.ontos.com/o_eng/index.php?cs=2-1 accessed 2 August 2010

O'Reilly, T. (2005), [online], *What is Web 2.0?*, http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html accessed 14th July 2010

Patrick, K., & Dotsika, F., 2007, Knowledge Sharing: Developing from Within The Learning Organization: The International Journal of Knowledge and Organizational Learning Management, Vol 14, Iss 3, July 2007.

Rangaswamy, A., CL Giles, Seres, S., (2009) A strategic perspective on search engines: Thought candies for practitioners and researchers, Journal of Interactive Marketing 23 (2009) 49–60

Ray, A., Ray, J., (2006) Strategic benefits to SMEs from third party web services: An action research analysis, The Journal of Strategic Information Systems, Volume 15 Issue 4, December, 2006.

Rector A.L., Wroe C., Rogers J., Roberts A. 2001 Untangling taxonomies and relationships: personal and practical problems in loosely coupled development of large ontologies. K-CAP 2001: 139-146

Semantic Cloud API, (2009) [online], http://www.semanticengines.com/api.aspx accessed 2 August 2010

SemanticHacker, (2008) [online], http://www.semantichacker.com/ accessed 2 August 2010

Shaw, T., (2010) [online], Can Web 3.0 save the publishing industry?, http://www.econtentmag.com/Articles/ArticleReader.aspx?ArticleID=67796 , accessed 2 August 2010

Shuen, A., (2008) Web 2.0: A Strategy Guide Business thinking and strategies behind successful Web 2.0 implementations, O'Reilly Media, Inc

Smith, G. (2008). Tagging: People-Powered Metadata for the Social Web. Berkeley, CA: New Riders.

Smith, M.K., Welty, C., McGuinness, D.L. (2004) [online], OWL Web Ontology Language, http://www.w3.org/TR/owl-guide/ accesses 24 July 2010

Specia, L. and Motta, E., 2007, Integrating Folksonomies with the Semantic Web, in the Proccedings of 4th European Semantic Web Conference, Innsbruck, Austria.

Udell, Jon (2004), [Online], Collaborative knowledge gardening, InfoWorld. http://www.infoworld.com/article/04/08/20/34OPstrategic_1.html , accessed 28 July 2010

Van Damme, C., Hepp, M., Siorpaes, K. (2007). FolksOntology: An Integrated Approach for Turning Folksonomies into Ontologies. Proceedings of the ESWC 2007 Workshop "Bridging the Gap between Semantic Web and Web 2.0", Innsbruck, Austria, 2007.

Vickery, G., Wunsch-Vincent, S. (2007). *Participative web and user-created content: Web 2.0, wikis and social networking*, Paris: Organization for Economic Co-operation and Development

Wang, H., Huang, J. Z., Qu, Y., & Xie, J. (2004), Web services: Problems and Future Directions. *Journal of Web Semantics, 1*, 309-320

W3C 2001, [online], W3C RDF Core WG Internal Working Draft , http://www.w3.org/2001/sw/RDFCore/ntriples/, accessed 24 July 2010

W3C 2008A, [online] , SPRQL Query Language for RDF, W3C recommendation, http://www.w3.org/TR/rdf-sparql-query/, accessed 24 July 2010

W3C 2008B, [online] , Uncertainty reasoning for the WWW, W3C Incubator Group report, http://www.w3.org/2005/Incubator/urw3/XGR-urw3-20080331/, accessed 24 July 2010

Zemanta, (2009), [online] http://www.zemanta.com/api/ accessed 24 July 2010.

Zhu, H., Wang, RY, (2010) Information Quality Framework for Verifiable Intelligence Products, Data Engineering, International Series in Operations Research & Management Science, Springer, Volume 132, 315-333 2010.