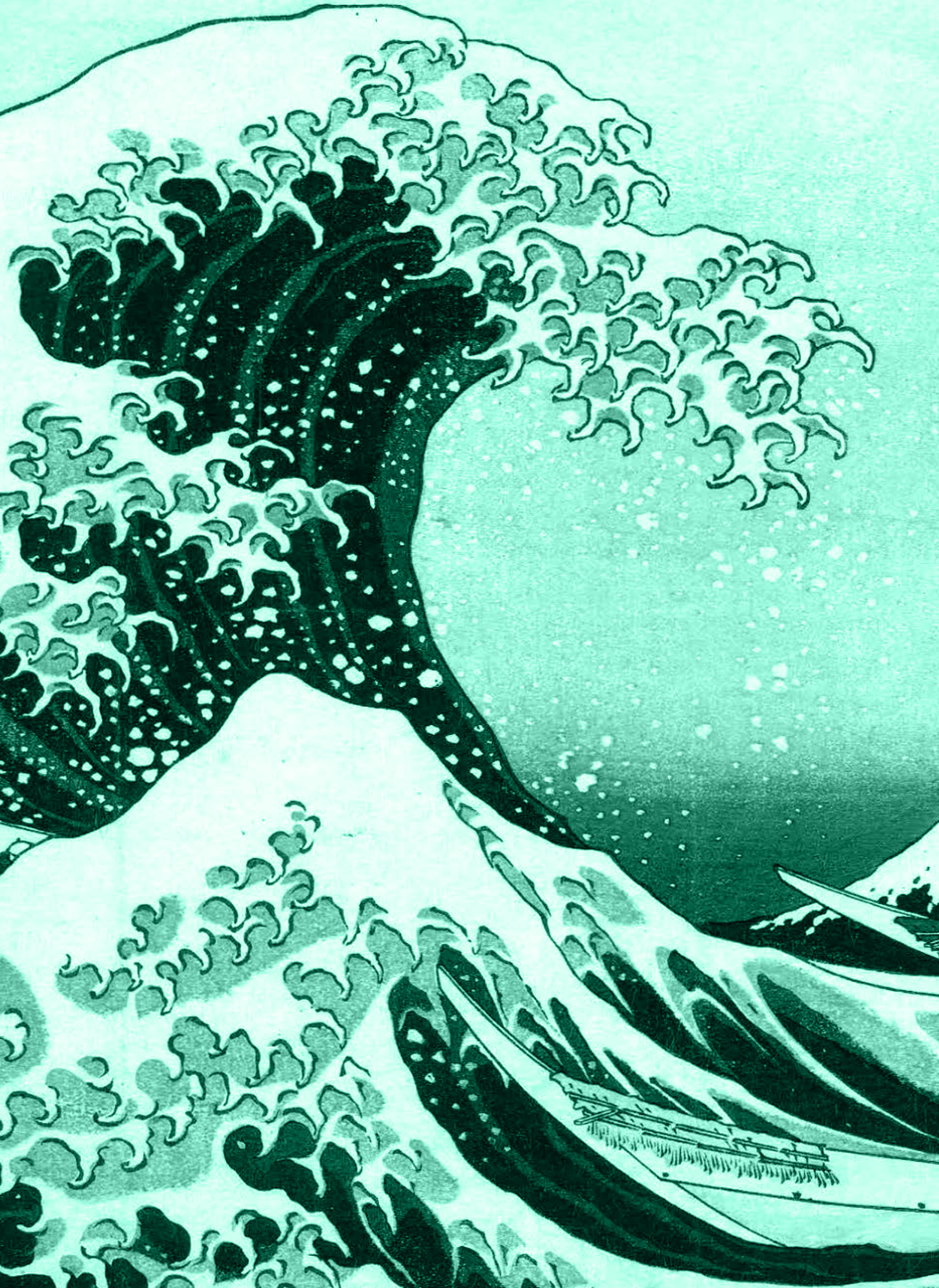

PEER-REVIEWED ARTICLE

THE PROBLEM OF DISTANCE – A RESEARCHSPACE CASE STUDY ON SEQUENCING HOKUSAI PRINT IMPRESSIONS TO FORM A HUMAN CURATED NETWORK OF KNOWLEDGE

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ABSTRACT | Technology is used to compress time and space but at the cost of 'nearness'. This means it maintains a distance and disjoint between qualitative and quantitative techniques, and therefore between humanists and technology. The knowledge representations that humanists require to investigate a given subject are not the same as those mandated by technologists and database systems more concerned with scale and the efficiency of data processing and retrieval, rather than context and meaning. This perpetuates a humanist perception of information systems as either, useful but ancillary, or problematic. This paper describes an intervention that seeks to combine the qualitative with the quantitative through collaborative research, expressive structured data, and a human-centered and participatory approach to the 'knowledge graph'. Its design is based on an understanding of the history of historical textual narrative and the benefit of approaching quantitative issues from the bottom up, or qualitatively, incorporating different levels of generalisation, perspectives (different vantage point on reality), and approaches to connections across time and space. A specialist question based on the designs of the artist, Katsushika Hokusai is used as a basis to illustrate how 'micro' research questions contribute, in part, to bigger questions and higher quality quantitative analysis.

KEYWORDS | network analysis, interdisciplinary collaboration, data-driven narratives, mixed-method, research environment.

"Thus emerges a pattern of one-dimensional thought and behavior in which ideas, aspirations, and objectives that, by their content, transcend the established universe of discourse and action are either repelled or reduced to terms of this universe. They are redefined by the rationality of the given system and of its quantitative extension."[1]

Distance

How do you like to think? Through the practical activity of doing, oral dialog, or the act of writing? Perhaps by drawing or other artistic outlet?[2] The main way that researchers ultimately present their knowledge is textual and 'unstructured'[3], typically using descriptive and analytical narratives - the kind found in the books and articles that we read on a regular basis, both analogue and digital. This type of narrative is at the center of educational and academic frameworks, while other forms of communication, like visual reading, remain pushed to the sidelines. It is still in the textual narrative that we mainly entrust our thoughts, intuition, creativity and experience. This also applies to art historians who, despite their particular focus, also express their research in textually rich journals and books. However, in this paper we address the question of how structured data can be used in practical thinking, and how 'thinking with data' can inform, through collaboration, the creation of a larger, yet highly detailed, knowledge base, one that reflects research, rather than provides a useful but reductive reference for it.

Both textual narrative and visual art allow us to convey complex ideas and arguments with different degrees of accessibility, but in an infinite variety of ways using different vocabularies, styles and structures, whether textual or visual. In their linguistic complexity, it is difficult to meaningfully integrate across them. One of the challenges of historical research is to incrementally and communally build sustainable knowledge that spans related or overlapping narratives. Growing and crucially connecting knowledge through narrative requires significant human effort and inevitably involves selection and omission. Helpers such as citations and hyperlinks, or the results of computational reading (natural language processing) are inconsistent and unreliable.

The amount of digital information in circulation, even within one discipline or sub-division of it, grows exponentially making interdisciplinary scholarship a logistical and, if there is any time left, intellectual challenge. Perhaps counter-intuitively, structured data, with its own form of artificial diversity[4], can be equally difficult to integrate semantically, or even technically, encouraging data aggregations that strip out what localised perspectives there may have been. In any event, databases remain distinct and distant in terms of their expressiveness and context from those of narrative, whether text, image or speech.

"Late Hokusai: Thought, Technique, Society" was a three year AHRC-funded research project between 2016-2019 at the British Museum and SOAS, University of London.[5] Like many similar projects it set out an ambitious brief aiming to bring together and grow new knowledge about Hokusai's life and work, in a short span of time. It draws from a large body of research and expertise used initially to create two high profile international museum exhibitions[6], while in parallel laying the foundations for collaborative international research enabled by a new type of knowledge system called ResearchSpace.[7]

ResearchSpace[8] is designed and produced at the British Museum by an interdisciplinary team, funded by the Andrew W. Mellon Foundation. It provides researchers with an expressive and relational (a focus on interconnected processes) way of using structured data.[9] Normally data structures are designed (use abstractions or generalisations) with quantitative use in mind. This different approach means that the basis for quantitative analysis is derived from expressive but structured qualitative data. This produces a viewpoint that is counter-intuitively rich (because of our trained mindset towards the database and its reductive and reference oriented worldview) with detail, including a dialectical mix of description, interpretation, belief and argument. More specifically, the abstractions (or patterns of knowledge) that it builds on relate closely to those that researchers would use in narrative rather than the technological abstractions that researchers are normally forced to use when working with databases. These technological abstractions, including documentation standards used in cultural heritage, tend to lack spatial and temporal "*extension*" (are static), apply a 'one size fits all' "*generality*", and represent the world from only one limited "*vantage*" point.[10]

ResearchSpace confronts two underlying issues associated with many types of database systems. Firstly, the nature and design of database architectures and an associated ingrained legacy of data modelling practices which is applied to different architectures, including new 'graph' databases;[11] and secondly, the mindset that these architectures and practices instill both in developers, and, counter to natural thinking, in their users.[12] Both ensure an adherence to a technological 'essence' that stands in contradiction (a paradox) to the knowledge systems of humanist/scientific research.[13] These database systems have some similarities with what historians called 'thin descriptions' and we refer to them as, 'thin systems' that produce, 'thin data'. They are typically used as finding aids and/or essential inventories, catalogues or references, despite sometimes being promoted as research systems. Thin systems and thin data have the following characteristics:

- They provide useful but relatively limited scholarly value because they are based on abstractions that prioritise efficiency and scale, rather than context and meaning.[14]
- They contribute to, but are at odds with, research methods which work within a complex and dynamic environment of continually changing knowledge.
- Their lack of an appropriate framework for including context and meaning prevents a meaningful open integration of heterogeneous data.
- They often fail to maintain an adequate history of their knowledge - a necessary yet missing component of many historical and social science systems.
- They provide networks of facts, devoid of interpretation and theory.

As such we define 'thin information systems' as:

"An information system that stores and processes structured data with a predefined data model, used to record independent instances of entities with little or no explicit semantics or contextualised relationships, typically presenting information in absolute time and space for the purpose of creating a finding aid or essential reference."— Oldman and Tanase

In contrast ResearchSpace is based on the following principles:

- Qualitative information can be expressed in structured data patterns using an onto-epistemological approach.
- The provision of context at the ontological level provides a means for integrating heterogeneous data across traditional disciplinary boundaries.
- Combined with a new mindset, structured data environments can become dynamic knowledge environments that treat entities as processes and maintain a history of knowledge using chains of interpretation and argument.
- Digital environments should allow scholars to 'grow' information in many directions without constraints,

leading to long-term sustainability of information based on use value.
- They should provide dynamic and diverse networks of knowledge with wider participation.

We characterise this type of system as a 'thick information system' being defined as,

> *"An information system using structured data in which there are flexible and expandable structures of information supporting different interdisciplinary vantage points describing internally related processes [entities] with explicit semantics and context, and where processes can be connected across different types of time and space, whether absolute, relative or relational."* — Oldman and Tanase

The notion of a thin system and thin data is borrowed from a debate in History about the role of textual narrative. What emerged from the modernist movement of the first part of the 20th century was a scientific approach culminating in structural history or analysis that sought to tackle big and complex social, economic, geographical and demographic issues. By the 1960s structural history was at its height, but from it emerged a wider community of progressive historians whether based in human geography, sociology or in marxist and social science methods. This community, as the historian Hobsbawm summarised, resulted in, "a transition from quantitative to qualitative studies, from macro- to micro-history, from structural analysis to narrative, from the social to the cultural."[15] It became known as a thick description that offered a richer, interpretative approach with context, and attempted to incorporate a manageable underlying argument, addressing perceived issues of quality, transparency and accessibility.[16]

In practice, thick descriptions have mostly been associated with microhistories, the intense investigation of a particular subject at smaller scale, which, in theory, provides the basis for better generalisations and questions.[17] Levi states that "microhistorians have concentrated on the contradictions of normative systems and therefore on the fragmentation, contradictions and plurality of viewpoints which make all systems fluid and open".[18] In their process individual interpretations of different historians is not a view of history as a rhetorical or aesthetic activity, but rather part of, 'scientific' enquiry in which interpretation and vantage point is a component. Understanding local human behaviour in the context of a global perspective means identifying, understanding and resolving questions and contradictions. It does not imply that everyone's subjective opinion is correct.

In addressing the relevance of microhistory to global history, Ginzberg writes, "the notion that a case-study focusing on an anomaly may be the best strategy to build up a generalization. A close analysis of a single case study may pave the way to much larger (indeed, global) hypotheses."[19] We argue that in practice this intention to inform a wider agenda was, and is, hampered by reliance on just a purely narrative form and the difficulties they present for comparing both the content and underpinnings of such interpretations and generating quantitative knowledge. On this we also note the warnings of historians like Hobsbawm about the 'myths' that local histories can produce.[20] We further argue that a more expressive type of structured data, coupled with a collaborative, 'thinking with data' environment can address previous issues with quantitative techniques and provide a multitude of vantage points for tackling big history questions backed by quality detailed research which is transparent and accessible.[21] There are clear academic differences between expressive data and thick narrative descriptions, but in the former, data can be used to handle informational complexity and provide an ontological backbone that incorporates a provenance of argument.

In reducing the distance between qualitative and quantitative techniques and making them part of the same process ResearchSpace needs to make inroads on the relationship between human and computer. Consequently, while in computer science, "[a] knowledge graph acquires and integrates information into an ontology and applies a reasoner to derive new knowledge",[22] this definition is rejected and replaced with:

> *"a knowledge graph is a continually changing informational structure that mediates between a human, the world and a computer. The graph itself is ontologically based and enhanced by human epistemology. These are closely linked in that the ontology provides real world references and a structure of interrelated entities or processes, while the epistemology uses the graph to interpret and generate new knowledge. Growing the graph is based on both automated reasoning and crucially, collaborative human thinking and creativity."*[23]
> — Oldman and Tanase

This reduction of distance between human (subject expert) and computer confronts known concerns within the art history community about 'digital art history', relevant to all art historians both within their specialism, but also in their relation to other disciplines, whether categorised as humanities or science.[24] ResearchSpace aims to create a dynamic knowledge system, rather than a static reference resource, that can be enriched and sustained by a wider community of scholars. The intention is not to be either qualitative or quantitative but to create a 'nearness' between them. To create a growing *detailed panoramic* view that layers different perspectives to a continually growing landscape of knowledge.

Challenging Practices

Many researchers already use digital and online tools but mostly in an ancillary way. They subscribe to online applications that organise their notes, images, citations and collected materials; they use structured data, through personal spreadsheets or desktop databases with limited readership; they use online references and may also rent Web space in the cloud and share or network data resources. However, these digital supports are ultimately geared towards a final *textual narrative.* Much of the 'working out' whether captured on paper or digitally does not appear in either the database or the journal publication, and is best kept hidden away from critique.[25]

One aim of ResearchSpace is to transfer and elevate these underlying processes and workings, whether performed through an analogue or digital form, and support them using a semantically coherent framework. This framework, called a computer ontology, creates a universal framework of explicit meaning described in terms of clearly defined real world entities (processes) with different levels of generalisation/ specialisation (persistent and temporal, like a physical thing and a man-made object, or an event and a specific activity). This framework integrates previously separate and diverse datasets without losing individual characteristics, but more importantly allows new knowledge to be represented with semantic and contextual precision.

It is designed to remove the 'stigma' attached to revealing how interpretations, connections, and changes in knowledge have been arrived at. Rather than being embarrassed by the inherent gaps in available sources of knowledge, it promotes a scientific environment that acknowledges their importance, and that of different interpretations and perceptions, as part of the *scientific process* to understand past and present reality. In this new environment, the complexity of historical scholarship, it multiple methods and theories, conforms more closely to an ongoing scientific project in which different interconnected branches are progressed and enriched, while others result in dead ends but whose depreciation is a valid and constructive part of the approach.[26]

The historian Keith Thomas stated that, "[i]t never helps historians to say too much about their working methods. For just as the conjuror's magic disappears if the audience knows how the trick is done, so the credibility of scholars can be sharply diminished if readers learn everything about how exactly their books came to be written".[27] To regain relevance and significance, and to tackle fragmented scholarship, this defensive position needs to be reversed. It is important to demonstrate that there is no magic, but just a continually developing understanding based on growing collaborative knowledge that can be exposed incrementally and explicitly in a timespan not possible with traditional publication.

When some humanists passed negative judgements on the scientific and quantitative approaches of the 20th century they were not without some reasoning. However, quantitative methodology clearly offers necessary and invaluable insight and it is the *failure of humanists* to engage in the redesign of information systems to reflect their needs and logic, ensuring that databases remain ancillary and firmly within the knowledge domain (and logic systems) of computer and information scientists, who apply a different type of abstraction and logic. For example, Langmead et al. suggest a role based framework that attempts to mitigate quality issues with 'grunt' input database systems[28] using oversight, accepting their inherent issues rather than challenging their design and making experts both the designers and authors of data.[29] If database systems do not warrant the expertise of the subject experts directly, it must be because they are not designed to accommodate that expertise.

The Hokusai project provided a dilemma in that the partner institutions own database systems that 'document' many of the objects that form part of the research corpus. These essential 'institutionalised' records provide a reference that describes the properties and provenance of material objects and their creators. It is not their purpose to anticipate and provide the information (even if that were possible) to answer the research questions. They provide only a faint implication of 'Thought' and 'Society', and there are few details of 'Technique' beyond basic production information.

It is not simply a lack of ability to represent the complexity of the mechanical reproduction process of woodblock printed media, but more that these systems are not designed to relate information to society. They provide a useful reference to what exists, but this forms only a small fraction of the overall sources needed to conduct research. However, transferring them into a shared digital environment can require large amounts of technical work, including fixing decades of data issues (inconsistent practices, poor data validation, and so on) required for turning a system originally designed for internal institutional use, into an open (in the sense of openly meaningful) external one. This effectively delays research particularly if the project is dependent on digital tools and data aggregation. Moreover, the results of that research are likely published independently of those databases and have little impact on them.

Sources and Forms of Information

In recent years digitally engaged communities, like Digital Humanities, has focussed considerable time and resources on

the environments needed for collaborative digital research.[30] For example, the Digitised Manuscripts to Europeana (DM2E) project looked, 'beyond the infrastructure' (the technical infrastructure addressed by reports like Atkins[31]) and instead paid attention to the process of research itself within the infrastructure.[32]

This journey from the abstract to the concrete involves the use of generic high level primitives proposed as, "interpretative modelling, exploration, aggregation, augmentation and externalisation", which are involved in particular, but also generic, activities, ultimately part of scholarly operations (a specific research scenario)[33]. The aim is to emphasise that infrastructure itself is not research, and to focus on the processes that need to be supported within a research environment. These primitives and activities have been discussed and elaborated by many, but rarely do projects go 'beyond activities' and examine the underlying theories and practices, the epistemological and cognitive processes, and the forms of information on which these activities can *effectively* operate.

In DM2E, content, or input, is any information object that a scholar collects or aggregates for the purposes of research. Output, is any information refined and made into an externally citable information object. The idea is that information is sourced and organised in ways that allows scholarly processes to be effectively applied to it. Those processes are used to create new knowledge, addressing research questions, and this is then disseminated and used as input elsewhere. However, while infrastructure is not research, research processes depend on the nature and quality of the sources they operate on, and the types of abstractions they make, to organise research objects.[34] This determines their value to other research projects. If inputs are of poor quality then 'refinements' are difficult regardless of the scholarly processes applied.[35]

In addition, the theoretical frameworks of the digital tools themselves are often overlooked in favour of the novel but discrete 'functionality' they provide. The separation of scholarly function by, for example, Digital Humanists, is reflected in the componentization of digital tools leading to a fragmentation of scholarly activity that would, using a narrative, not usually exist.[36] For example, the use of Actor Network Theory (ANT), lends itself well to the digital construction and the visualisation of relationships for example, people, but its theoretical underpinnings are not without issues, and in particular its separation from other contextualization.[37] In this case, some of the controversial elements of ANT are magnified by digitisation, but in practice these considerations do not inform the design and construction of tools, and users of it may be unaware of its potential shortcomings. They are drawn into its technological appeal without considering scholarly value. The accessibility and novelty of a digital tool may mask theoretical issues and may risk being at variance with progressive scholarship.[38]

When it comes to structured data, whether a new database, aggregations of existing ones, or the indexing and tagging (manual or automated) of unstructured sources, the quality of information, in terms of active research, is determined by whether they allow effective meaningful community knowledge building. However, the conventions of library and information science have been oriented primarily towards a 'retrieval' based paradigm and on providing the means of finding the 'actual' information - a book, image or an article, for example. Day points out that the expansion of online search systems and digital infrastructures coupled with the broadening of what is called information, or 'informative', has led to a de-professionalisation of documentary structures and a transformation of 'documentation' into 'information'.[39] While this means a far more varied landscape of databases, the underlying document and retrieval mindset is still dominant. For example, Google's Knowledge Graph, is still very much part of the old paradigm despite its 'knowledge' branding. To create a true knowledge graph using the definition provided above, a new type of database, or knowledge base, is required.

In 2013, Drucker asked whether a digital art history existed, and envisioned a way in which it might be supported in the digital space. The picture she painted was not one of discrete visualization and retrieval tools but to "situate a work within the many networks from which it gains meaning and value, and then present the results within *complex visual arguments*—the kind that were elaborately constructed on slide tables before being reduced to side-by-side comparisons for lectures or standard print publications."[40] In other words to support a scholarly activity that underpins many others - that is an 'argument'. In 2013 Drucker thought we were some distance away from this, and the details she provided of this scenario were sparse. This might be because the methods through which these digital networks of meaning and value may be established are fundamentally complex, and are not technology, or business driven.

Our thinking and mindset towards the digital is directly related to the *one dimensional* presentation of technological advancement under the terms of 'technological essence'. In order for subject experts to directly author a semantic, structured data argument, new dimensions are needed. Despite apparent increases in interdisciplinary working, access and control of the forms of data representation are divorced from subject experts who, from a non-technical perspective, understand the appropriate structure, context and interpretations, but have insufficient knowledge to challenge technical conventions. One knowledge system hits the barriers of another.

Subject knowledge is mediated, reinterpreted and reduced by the knowledge systems of technology which drive an ontology of efficient data processing and scalability, but lack the ability to support the level of meaning necessary for complex collaborative knowledge building. This fails to compete with traditional narratives in key areas of research and to develop into more than a reference for research (with question marks about sustainability) done elsewhere.[41]

The approach described above is unable to facilitate a representation or integrate knowledge as a dynamic form, one in which entities are, in fact, constantly changing processes because of their mutually dependent relations. Such a reality requires direct human curation. Just as writing and thinking are intertwined, digital research spaces using structured data should be conceived not simply technically mediated abstractions of previous thinking, but also as places where thinking and data authoring can also be combined. They should be spaces designed to provoke and nurture knowledge generation and record it in suitably expressive (meaningful) data forms for human and computer interpretation. Networks of meaning and value cannot be created from discrete project generated reference systems and tools. Data should not be seen just as an input for searching and quantitative database queries, but also as an authoring tool for subject experts directly to generate information reflecting their ongoing thinking and knowledge. In addition, the environments that they contribute to do not present one atheoretical representation but present and integrate multiple perspectives (different vantage points of the same reality).

The Process

We define scholarly collaboration as a combination of the following; From the Oxford English Dictionary, "*United labour, co-operation; esp. in literary, artistic, or scientific work.*"[42] This is extended by the Cambridge University Early Modern History department which talks about cooperation as a, "*...shared commitment to exploring the ...world in all its diversity, complexity, and interconnectedness complement[ing] the vigour and enthusiasm with which we individually pursue specific problems.*"[43] In addition, we believe that it should also be interdisciplinary, defined by Stember as; "*... the integration and synthesis of knowledge toward a more complete understanding of the whole*". [44]

This implies that collaboration can be multidisciplinary in terms of involving people from different disciplinary traditions who work towards an interdisciplinary outcome, and that they cooperate towards a common purpose, which may result from a question or set of questions. From this we derive the following definition for the purposes of this paper:

> *"Scholarly collaboration is the process of cooperation between two or more scholars, who may be attached to different disciplinary traditions, acting with a common purpose to explore the world in all its diversity, complexity, and interconnectedness, using a methodology that integrates, resolves contradictions, and synthesises knowledge towards a complete understanding."* — Oldman and Tanase

In online digital information systems, we confront what Heidegger called the 'essence of technology', not the technology itself but the underlying forces that treat everything else as an object or resource for its use, including people.[45] Despite our perception that humans direct and control technology, "[o]ur attempts to master technology still remain *within its walls*, reinforcing them."[46] While technological essence is an unavoidable part of technology in its widest sense, Heidegger's strategy was to emphasise that things can be revealed in other ways, not just through technology. Open and collaborative information systems, whether encyclopedic services such as Wikipedia[47] or data aggregations like Wikidata[48], Artstor[49] and Europeana[50], bring collective information together but only within their technological terms. In Wikipedia for example, contributors edit entries together converging towards 'neutral' accounts of things, places, ideas and so on, under particular rules of representation which seem very similar to reference databases. In this case, collaboration is not used to collect different perspectives or to provide different 'vantage' points, but to distill an impossible single neutral position and in doing so risk a significant distortion of reality. Similarly, data aggregations (online databases) pass on the inherent characteristics of the legacy internal documentation (inventory) systems but on further reduced terms. This is illustrated by external commentators to the Digital Humanities movement such as Reisz who starts his article, 'Surfdom', with the statement, "[t]he internet has

revolutionised humanities research. But has the development of ever-more sophisticated online resources freed up scholars to explore new ideas, or made them slaves to the digital machine?".[51]

What is potentially different about the Late Hokusai project is that it connects to other resources on different levels, both as a contextual resource within a particular space and time, but also as a contribution to broader generalisations *across* space and time. As an example, Hokusai might be situated in a growing knowledge base that encompasses a larger network of processes in the same proximity or period, or more generally contribute to a history of technology and art, or the comparative development of capitalism across different regions. It can address different agencies.

One of the key factors in making Hokusai a multi-dimensional and multi-layered resource will be the potential for collaborators to assert and argue their different perspectives. ResearchSpace provides an ontology-based mechanism for growing knowledge structures that contain, not just information about things, but interpretations. The generative process is driven by a collection of 'knowledge patterns' which capture information patterns of relations between things, material or non-material, contextualising events. These are formally expressed using an event-based ontology called CIDOC CRM (Conceptual Reference Model). The ontological representations enable the expression and linking of assertions and arguments into chains of arguments that themselves can be subject to further analysis and argument.

The Hokusai Case Study

Mount Fuji is a significant cultural symbol in Japanese society, and often featured in the art of Tokugawa period (1615-1868) artists, including the most famous in the West, Katsushika Hokusai. In a series of single sheet impressions called Fugaku sanjūrokkei 富嶽三十六景 ('Thirty-six Views of Mount Fuji'), Mount Fuji is depicted in various contexts and from different positions of distance. In the making and appreciation of art, distance is a significant concept. For example, between viewer, art and artist, or between artist, curator and institution. In the following, a type of distance is apparent in woodblock printing - that between the artist (or designer), the block cutter and the printer.

When Hokusai produced a design, he would at first sketch it roughly, and then reproduce it as a block-ready drawing (版下絵, *hanshita-e*). The block cutter used the *hanshita-e* as a template for cutting the lines of the design onto a keyblock, usually the close grain of cherry wood.[52] This woodblock production line inevitably created distance between designer and printed impression. While the artist may control the artistic direction at the beginning, this is not necessarily extended to all the impressions printed over a period of time. The original artistic intention, captured in the lost design, became subject to other decisions. These might have been affected by wear and tear to the set of woodblocks, costs and efficiency, market demand, availability of different pigments, different printers and their influence over the process.

Alterations, damage and block degradation, resulted from a standardised and commercially-driven printing process which was subject to cost and passing through the hands of those with different priorities, knowledge and mindsets. This scenario is still common today, including digital mediations. In modern day Tokyo, Hokusai might produce his design and variations thereof using design software. Digital technology has given designers more control over the production line through computer aided design applications, accessible high quality printing apparatus, and generally lower costs.[53] Nonetheless, the computer application still exerts influence over the process. A modern day Hokusai working in this context would need to evaluate artistic considerations, financial benefits and the benefits and constraints of the technology.

As the condition state of the set of woodblocks created from Hokusai's design deteriorated, the impressions taken from them reproduced this change. Changes made in the printing process also resulted from the use of different pigments, different emphasis (using varying pressure), and general changes by printers whose artistic supervision was likely to lessen over a period of printing involving hundreds or thousands of impressions. For example, the iconic woodblock print, *Kanagawa oki nami ura* 神奈川沖浪裏 ('Under the Wave off Kanagawa', commonly known as 'The Great Wave') can be found in various collections around the world. Yet, these several hundred impressions[54] are not identical, exhibiting a range of differences in line, colouration and features. Impressions of *Gaifū kaisei,* 凱風快晴 ('Clear Weather, Southern Breeze'), also by Hokusai and, like The Great Wave, part of the Fugaku sanjūrokkei series, exhibit considerable and obvious differences between versions such as a transition of the mountain's colour from subtle pink[55] to bright red[56], and to an entirely blue colour palette[57]. A close, comparative visual analysis of impressions of the same set of printing blocks that display changing features over time leads to the establishment of a sequence in which the impressions were printed. From this knowledge, broader understanding of the production process at the time can be evolved.

The production process for impressions is also inextricably tied up with other aspects of society; "technology", "relation to nature", "modes of production", "social relations", "mental conceptions of the world" and the "reproduction of everyday life".[58] In other words, the specific research question is not independent of other processes and naturally contains a meaning and value that is part of, and connected to, a social

Figure 1. - The ResearchSpace resource - Late Hokusai – Image. © Trustees of the British Museum.

totality. These complex relations are problematic to represent whether in narratives or in database structures, hence the original debate about the relative merits of different narrative forms, and the trend towards thick descriptions of narrower subjects. The issue is then, how do these narrower thick descriptions ('microhistories') establish relations between them, and to what extent can their dynamic nature be represented and analysed as a whole?

In revisiting the question of 'impression sequencing', the Late Hokusai project reviewed the catalogue raisonné[59] and other primary and secondary sources. In respect to Keyes and Morse's notes, 'the working outs', it is normal to find that, over the course of time, certain details recorded in shorthand at the time of writing, become ambiguous. The accessibility of the final narrative hides some issues of precision and terms of reference. For example, to what extent does a set of woodblocks have to change in order for impressions to change in status or identity (transformation) and what ontological and epistemological implications does this have? We are reading a perspective and judgement which is not shared by all scholars in the community. But surely, what else would we expect?

If data is seen as a form of communication that can express interpretation and argument, then digital systems start to challenge established mindsets and provide something that traditional narratives and databases have failed to provide coherently - the ability to deal with complexity of perspective at different levels of generality (from agency at one end to more structural abstractions at the other). The value of structural approaches, the longue durée, the original promise of quantitative history, the development of narrative, the use of thick descriptions, and the application of microhistories, all provide a backdrop for the design of structured data knowledge systems that shifts research, at least to some degree, from a selective and fragmented activity to one that can reflect different aspects of this evolution. Scale is achieved through detailed collaborative research but operates within a framework of increased complexity rather than enforced reductionism, in a computer readable form. Distance is achieved through nearness.

Impression Production: From Technique to Thought and Society?

In the Late Hokusai project the start of a 'thick data' description (an initial perspective) is created using the CIDOC CRM (Conceptual Reference Model). It provides the scaffolding for a much wider collaboration of views and context. The initial focus of the project centered on the events and relationships involved in the impression production process itself. Figure 2. shows a generic representation of foundational processes using the CIDOC CRM. This is not a diagram but a visually authored knowledge base.

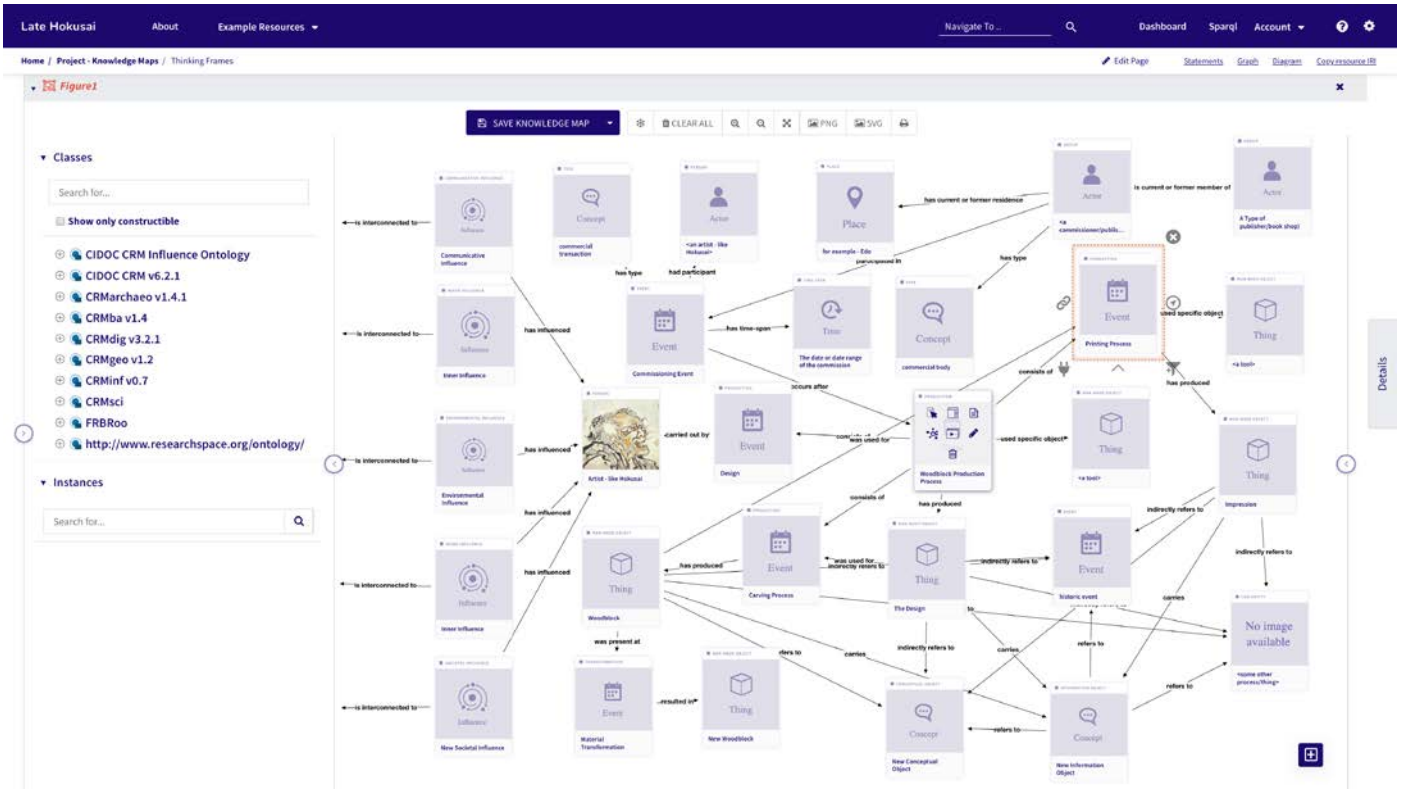

Figure 2. The Knowledge Map. Image of system © Trustees of the British Museum.

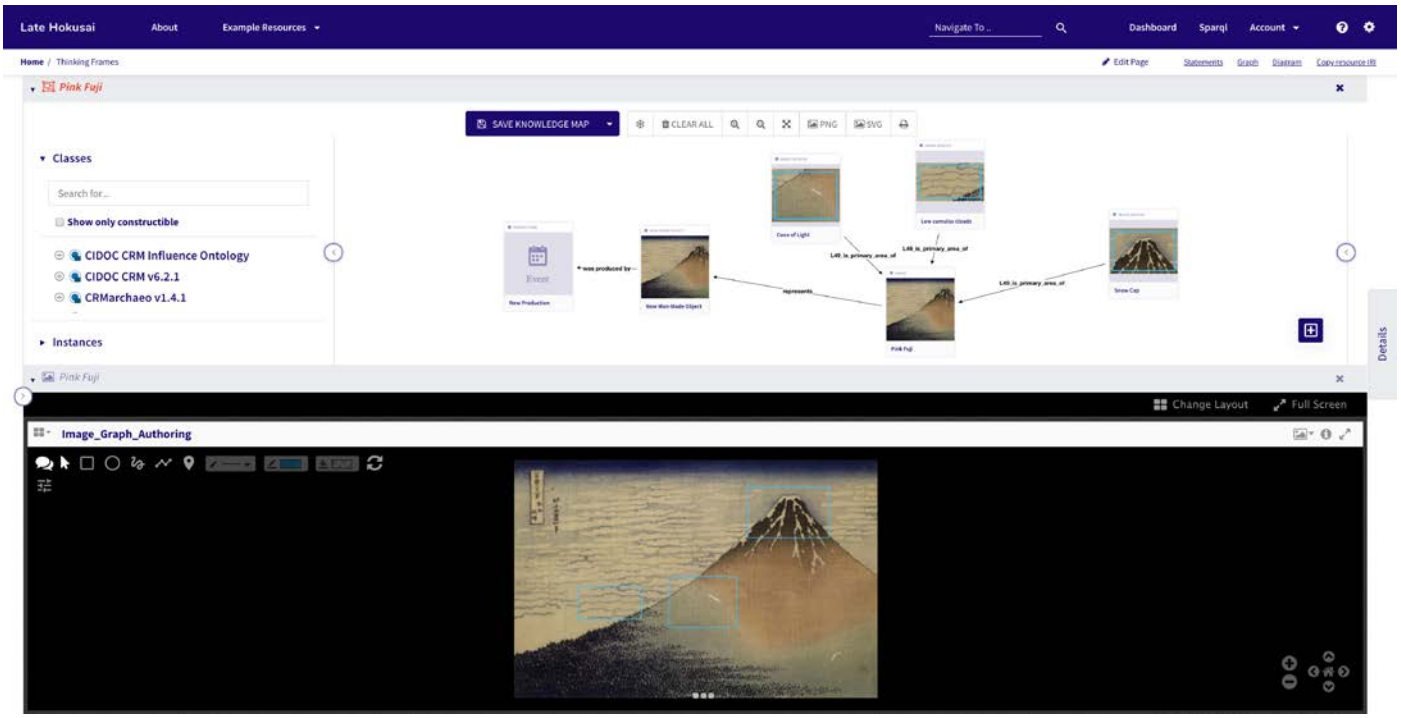

Figure 3. - Image Graph Authoring. Image of system © Trustees of the British Museum

NARRATIVE	STRUCTURED DATA		
The set of woodblocks changes in its qualities. In this case it is transformed by two modifications. The set becomes something new with a new identity.	Woodblock set	Has condition state	<a condition state>
	Condition state	Has a time-span	Date range
	Woodblock set	Has a time-span	Transformation
	Transformation	Has type	Multiple modifications
	Transformation	Result in	Transformed woodblock set
	Woodblock set	Bears feature	Physical feature 1
	Woodblock set	Bears feature	Physical feature 2
	Woodblock set	Bears feature	Physical feature 3
	Transformation	Consists of	Modification 1
	Modification 2	Modified	Physical features 2
	Transformation	Consists of	Modification 3
	Modification 3	Modified	Physical features 3

Table 1. Modification and Transformation. This is not a full description and just a subset of example processes and relationships in a pseudo format.

This initial information is basic but shows the principles of producing contextualised data with explicit semantics that create 'event-thing' (material and immaterial) patterns enabling integration and discovery over heterogeneous datasets. The model could be extended to emphasize, for example, the economic aspects of this process (perhaps a full representation of the market and its link with other commercial activities, such as courtesan services) or the influences and social factors that affect it (both in terms of structure and agency). It could therefore also be used for a comparative examination of particular social norms.

Through a knowledge mapping environment subject experts can visual build or grow the knowledge base, expressed ontologically, but stored as Linked Data. It allows new processes and relationships to be added as research inquiries progress. 'Knowledge Patterns' can be indefinitely expanded. For example, in the case of the early impression of Clear Weather, Southern Breeze, one might add a knowledge pattern that allows the assertion that, an impression carries a concept (an information object) and that this information refers to 'morning' or 'dawn'. It could also add a proposition (Propositional Object) that talks about its significance, perhaps linked to a religious belief of the artist. The knowledge can be directly abstracted from images of the objects in question. Figure 3, shows a ResearchSpace IIIF system customised to represent regions of an image (such as an impression) as ontological entities in a Knowledge Map, which therefore can be extended and interconnected with other knowledge.

The Knowledge Map (Figure 2) also provides the beginnings of a mapping charting the state of woodblocks over time. As already mentioned, the woodblocks which were used for printing became worn and the impressions in turn were affected, but equally, person-made changes might be applied, for example, the removal of a worn section or seal. The figure might follow the set of statements shown in table 1.

The first aspect of this non-specific example is that these statements are deemed to be beliefs. For example, there may be no direct evidence that an artist was commissioned by a publishing house, but the appearance of the publishers' seal and the need for an artist to be paid, may infer that the publisher commissioned the artist. This type of assertion can be part of a structured statement with a level of certainty attached. In ResearchSpace, existing statements can be used as premises for new arguments, that result in new beliefs as conclusions. This means that researchers do not have to agree a single position before entering data, but can provide different points of view and add evidence found as part of their ongoing investigation. This also changes the nature of the information that can be encoded as data. In Figure 4, one Knowledge Map is used as a Proposition Set for another, allowing different beliefs to be linked and either adopted or argued with different premises.

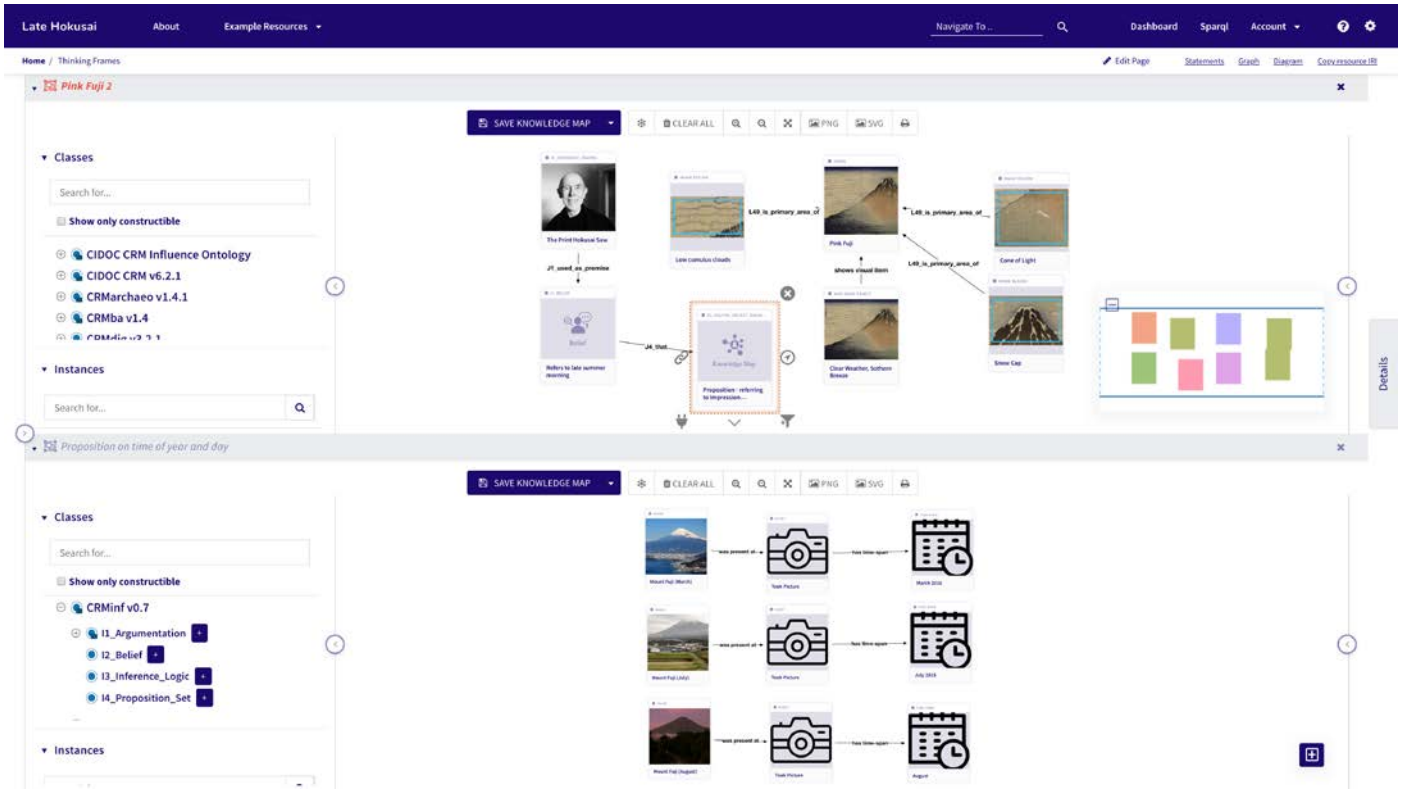

Figure 4. Empirical Evidence of Season. Image of system © Trustees of the British Museum.

These principles also apply to the complex artist, block cutter, printer relationship. There are significant gaps in the documentary evidence and the interpretation of impressions becomes important and perhaps helped by other case studies that build up of a knowledge of certain practices. The changes that occurred to the woodblocks either intentionally or naturally over time may be seen as inconsequential modifications, but others might be seen as transformational. In CIDOC CRM, 'Modification' is defined as

> *"all instances of E7 Activity that create, alter or change E24 Physical Man-Made Thing. This class includes the production of an item from raw materials, and other so far undocumented objects, and the preventive treatment or restoration of an object for conservation."*

A modification of an existing object does not change its identity. This contrasts with another concept (or process) in CIDOC CRM called 'Transformation'. This is defined as

> *"...the events that result in the simultaneous destruction of one or more than one E77 Persistent Item and the creation of one or more than one E77 Persistent Item that preserves recognizable substance from the first one(s) but has fundamentally different nature and identity."*[60]

ResearchSpace provides an onto-epistemological approach. A computer based ontology is still concerned with existence, being or becoming, and material reality. However, over and above this humans construct philosophies, theories, models, ideologies and conventions that create artificial spaces or abstractionsuseful for analytical purposes. 'What is a modification of a woodblock?' and 'what is a transformation?' may be viewed differently by different people depending upon a particular vantage point. Despite convergence there still exists two art history traditions one concerned with a tradition of aesthetics and connoisseurship, and the other concerned with social history, agency and wider social implications.[61] Within these backgrounds different opinions and interpretations can be accommodated against a common ontological foundation. This 'real world' backdrop helps us to identify and understand many of the contradictions between these different standpoints. These questions are not just relevant to the domain of art historians but have resonance in wider interdisciplinary studies.

Keyes argues that, Clear Weather, Southern Breeze, was intended by the artist Hokusai to be set at a particular moment and climate and implies that future impressions were at variance with this artistic intent.[62] An argument connected to a set of beliefs can be constructed as a connected Knowledge Maps (Figure 4). This particular intent may at some point be evidenced through new knowledge that we find as an ongoing investigation, and added, while other researchers may consider and collaboratively argue about wider implications. To this end the CIDOC CRM

allows us to talk about external influences, motivations, ideas and concepts that we can tie to these practical and material things. The types of things that we can expand with the same process might include:

- The assertion that aspects of the impression refer to propositions (in CIDOC CRM, a propositional object) such as ideas and beliefs.
- The influence of foreign visual materials, particularly from China and Europe via Dutch merchants permitted to trade via Nagasaki during a period when foreign travel was forbidden[63]
- Comparisons with other archival resources about the general developments in late Tokugawa period society.
- Comparison with other regions and their social and economic development.

The network of knowledge from a single piece of research can become part of a wider knowledge base that talks to the fundamental interrelated concepts that underlie society, not just thought and technique.

Conclusion

Although using 'thin' and 'thick' textual descriptions to categorise information systems may at first sight seem uncomfortable, it allows us to provide an important generalisation to demonstrate the difference between systems that deal with a static network of facts and those that aspire to create a dynamic network of knowledge. The revival of the narrative and the thick description did not, despite the theoretical rhetoric, solve the practical problem of creating a whole from the many fragmented parts, and allow scholars to move seamlessly between qualitative to quantitative. ResearchSpace, the system presented here, approximates to a thick description approach, but with a crucial difference. The application of Semantic Web technology enables researchers to capture context and interpretation, with a view to supporting the complexity of structural analysis, the ones that narrative found it difficult to convey. This is achieved with transparency and accessibility for non-technical humanists. Woodrow Wilson said that:

> *"No piece of History is true when set apart to itself, divorced and isolated. It is part of an intricately pieced whole, and must needs be put in its place in the netted scheme of events, to receive its true color and estimation. We are all partners in a common undertaking, - the illumination of the thought and actions of men as associated in society, the life of the human spirit in this familiar theatre of cooperative effort in which we play, so changed from age to age, and yet so much the same throughout the hurrying centuries. The day for synthesis has come. No one of us can safely go forward without it"* [64]

This is something professional historians have strived for, but have been unable to achieve. Yet, with a different human mindset, computers can be made to work, at least to a certain extent, within our walls.

NOTES

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[3] No predefined model to which it adheres.

[4] Traditional data models are all different with no semantic element or agreement.

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[22] Lisa Ehrlinger and Wolfram Wöß, 'Towards a Definition of Knowledge Graphs', n.d., 4.

[23] Oldman and Tanase, 'Reshaping the Knowledge Graph by Connecting Researchers, Data and Practices in ResearchSpace', 330.

[24] Claire Bishop, 'Against Art History', Text, Franklin Humanities Institute (blog), 9 March 2017, https://humanitiesfutures.org/papers/digital-art-history/. - For example.

[25] Keith Thomas, 'Diary', London Review of Books, 10 June 2010, 36–37.

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[27] Thomas, 'Diary', 36.

[28] In other words databases used in research in which volunteers are brought in to input data separately from the researcher.

[29] Alison Langmead et al., 'A Role-Based Model for Successful Collaboration in Digital Art History', International Journal for Digital Art History, no. 3 (July 2018): 29, https://doi.org/10.11588/dah.2018.3.34297.

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[33] Digitised Manuscripts to Europeana D3.4 – Research Report on DH Scholarly Primitives, page 23

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