

The Shape of Time and Storifying Data

Modeling Historical Processes and their Temporal Dimension in Knowledge Graphs

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With the advent of more advanced computer technologies and large digitisation programs in art museums, archives, and libraries it is now possible to study the history of works of art and the lives of artists collectively using digital methods and techniques. We now have the capacity to revisit and test the conclusions of previous generations of individual researchers who attempted to identify significant patterns in the study of the arts (such as the development of styles and genres), but only had access to relatively small data sets. Recognizing the immense potential of big data a number of institutions have embarked upon ambitious linked open data projects.

The project *Golden Agents: Creative Industries and the Making of the Dutch Golden Age* (2017-2022) for example, aims at developing in a period of five years a sustainable infrastructure to study relations and interactions between 1) the various branches of the cultural industries and 2) between producers and consumers of creative goods across the long Golden Age of the Dutch Republic. The project will link distributed, heterogeneous resources (both existing and new) on the production of the creative industries in the Dutch Golden Age from heritage institutions such as the Rijksmuseum, KB National Library of the Netherlands, The Netherlands Institute for Art History and of academic institutions. Consumption remains an under-investigated topic with regard to the creative industries in the Dutch Golden Age. The digitisation of the enormously rich collection of the notarial acts (more specifically the probate inventories) in the Amsterdam City Archives, will provide data on the possessions of cultural goods by the inhabitants of Amsterdam what was one of the most important cities of the 17th Century.

The Golden Agents research infrastructure enables analyses of interactions between various heterogeneous (un)structured datasets by using a combination of semantic web solutions and multi-agent technology that will be supported by ontologies. One of the challenges is the modeling of ontologies for the historical processes of the interactions between various branches, and between the production and consumption of the creative industries of the Dutch Golden Age. These processes are described as multiple narratives for which we use the concept “storifying data”. These multiple stories developed over time in parallel orders, for instance the order in the making of an object (from idea to final product), the order of an object in the artistic life or oeuvre of their maker, the order between the original object and copies and transformations hereof and finally the order of the object within history.

For that reason the problem of representing time in linked data goes beyond the common practice in linked data projects of mapping a historical event in a given place to the right (Georgian, Julian, Chinese etc.) calendars. Important is the PeriodO initiative to create a

gazetteer of period definitions. However, it is not sufficient to map vague period names to more precise chronological coordinates as confined events. There is also a need to link and represent parallel, sometimes interacting developments over time. Promising is the storyline approach in the *Narratives in Digital Libraries project* (Bartalezi Lenzi e.a. 2017) that connects narrative events, but unfortunately does not allow for representing multiple time-sequences. We propose an innovative model that can describe these multiple storylines of ideas and objects. Moreover, we are in need of a model that takes ideas expressed by historians about the representation of time into account: "Like the astronomer, the historian is engaged upon the portrayal of time [...] both transpose, compose and color a facsimile which describes the shape of time," George Kubler (1962, 19) wrote in *The Shape of Time. Remarks of the History of Things*. This history of things does not only represent the history of 'material culture,' but reunites ideas and objects visually in temporal sequences (Kubler, p. 9). Time and the History of Things are crucial concepts in the Golden Agents project. Herein, we create so to speak a 'historical internet of things' of (im)material cultural objects and events of the Dutch Golden Age.

Kubler's description of the history of things as parallel sequential orders is not only relevant for a better understanding of the life-cycles of (im)material objects of the history of the Dutch Golden Age. Kubler's discussion of art history as a "system of formal relations" enables critical reflections on the historiographies of the concept of time of other disciplines as well. In Kubler's morphological analysis of duration in series and sequence, resonates Braudel's conceptions of plural time and serial history in human agency (micro time (events); meso time (cyclic processes) and 'longue durée' (structural change) that dominated the French historiography of the Annales School (Daley 2012). Recently, the theoretical physicist Carlo Rovelli (2018, 103) in *The Order of Time* argued that there is no need to choose a privileged variable and call it time. It would suffice to have a theory of dynamic relations that tells us how the things we see in the world vary with respect to each other.

While Rovelli is in search of a physical theory to understand the dynamic relations between the earth and the universe, our perception of historical relations within the world might be best captured by graph theory. It is revealing that the only image in Kubler's art-historical analysis of long before the digital era is a visualisation of a directed network. This paper explores the potential of Kubler's vision of (analog) multidimensional directed networks in which formal relations between ideas and objects build upon each other sequentially over time in a Semantic Web framework. The ultimate, practical goal of this exploration is to model and implement an ontology of parallel sequential orders of time that expresses historical processes. This ontology will make part of, partially extend the vocabularies of the most commonly used standards in cultural heritage and digital humanities, such as CIDOC-CRM and FRBR.

Citations:

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