Inversion Within Information Architecture: A Journey into the Micro–Meso–Macro–Meta

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Abstract The chapter discusses the impact of increasing amounts of information; the limitations of micro- and macro-models; the benefits of the levels of analysis framework introducing additional levels to manage information complexity; inversion as a mechanism to leverage complexity.

Introduction

The digital world has changed dramatically since the introduction of the World Wide Web in 1991. What was originally conceived as a hypertext information sharing system for CERN researchers 30 years ago, today touches every part of our lives with over 59% of the world's population, 4.57 billion people, being online (Statista, 2020b).

The number of people and the amount of time they spend online also increased exponentially, and with them the amount of information being created, consumed, and shared (Bulao, 2020). When the Web was launched there were 2,600,000 internet users, representing 0.05% of the world's population. Compare that percentage with 59% of people online as of July 2020. Today the Web represents a fundamental part of the online experience and has achieved adoption on an exceptional scale, providing a platform for other digital technologies to emerge (Krippendorff, 2005; Statista, 2020a) and grow through equally rapid adoption life cycles, including the smartphone, tablet, social media, and voice-operated technologies. These have in turn created increasingly more complex information environments people traverse during their day-to-day experiences (Lucas et al., 2012).

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The Impact of Increasing Information

In the early days of the Web, designers, and especially information architects, were concerned with the categorisation of information to support how people searched and navigated individual websites.

The pace and scale at which information is being generated and made available to everyone is still increasing, as are the means through which people can access and manipulate it. This very real "tsunami of data" (Wurman, 1997), flowing through innumerable devices to permeate society (Mitchell, 2003), has meant an exponential increase in the complexity of our information environments.

The field of information architecture has undergone successive waves of transformations in response to these socio-technical changes (Resmini & Rosati, 2012), with the latest wave emerging in the early 2010's and being largely driven by machine learning (ML) technologies used to comb through the constantly growing amount of information available. ML has allowed for the mass processing of data, the consequent automation of processes, and the implementation of real-time responses and interactions within dynamic digital environments. Engaging with the largest amounts of data available, rather than just acting on the information available requires a change in design perspective and, for information architects, creates a tension that can be considered contradictory. It introduces complexities that prompt the information architect to explore alternative ways of reducing the amount of information with which they are providing end users. It is a tension that exists between maintaining meaning and managing feelings of being overwhelmed and that was already identified by Wurman when he stated that "the creative organisation of information creates new information" (1989).

Increasing amounts of information creatively rearranged for a purpose can result in almost infinite information relationships and consequently potentially infinite patterns. Inversion is a way to approach this problem by means of an analytical evaluation of the data structures that make up those information relationships at different levels of analysis (Marr, 1982): in information architecture, inversion results in an approach that relies on the data generated from all interactions to shape the design of all and subsequent interactions.

This contribution adopts the micro–meso–macro model developed in evolutionary economics by Dopfer et al. (2004), applies it to information architecture practice to investigate inversion, and extends it to include Sheng and Geng (2012) additional meta layer to provide a fourth, more abstract view of an information environment. This extended model is the micro–meso–macro–meta model.

The Limitations of Micro–Macro Models

Micro–macro models have their roots in economics, in the work of Adam Smith in the eighteenth century and of John Maynard Keynes in the 1930's.

The advantage of a micro–macro model is that it has scale factored into it, so we can understand individual behaviour and how that manifests into market behaviour and vice versa. This understanding between micro and macro represents a relationship that can be studied and used to explain certain behaviours at different scales, either at a micro or macro scale. However, there are limitations with the model because of the implicit granularity at each end of the scale: whilst “the simplicity and elegance of the micro and macro models make them useful in explaining the price mechanism and the balance or imbalance of key aggregate economic variables (…) both models are unable to describe or analyse the actual behaviour of key market participants” (Sheng & Geng, 2012).

In the social sciences, this shortcoming has led to models that include intermediate steps of analysis to better understand existing relationships, provide greater levels of detail, and combat the “black box” approximations that naturally accompany a binary micro–macro mindset when describing human behaviour from an economic perspective (Bocong, 2012). Waltz’s level of analysis framework is one of the most used frameworks (Waltz, 1959).

Level of Analysis

Waltz’s level of analysis framework draws upon the field of international relations theory to explain conflicts from a micro, a meso, and a macro level. The micro-level represents the smallest unit of analysis (for example, a person); the macro level represents the largest (for example, a population); and the meso level sits between the micro and the macro (for example, a community).

The framework can be applied to explore integrated sets of relationships that can influence the location, size, or scale of a target event. It provides a foundation on which a picture can be built of how any relationship or set of interrelationships can increase in complexity because of a change in scale that in turn can represent differences in behaviour or feature. Specifically, we may observe behaviours or features at one end of the scale that does not exist at the other end of the scale.

Applying a level of analysis approach allows the exploration of those relationships that may exist between the big and the small, the part and the whole. It also introduces changes in the way information is understood and represented: the meso layer allows for the creation of three-way interrelationships where the micro–macro model only identifies simpler two-way interrelationships, providing more detail in support of understanding behaviour.

If we apply the levels of analysis approach to information architecture, we can abstract and represent information as a hierarchy that starts with data. The data can be abstracted to information; further abstracted into an information architecture; then abstracted again and shaped into an automation process that can, for example, be managed through machine learning algorithms. This ternary representation of abstraction can help us to understand the similarities and differences between data and information structures when we analyse them at different scales, for example helping

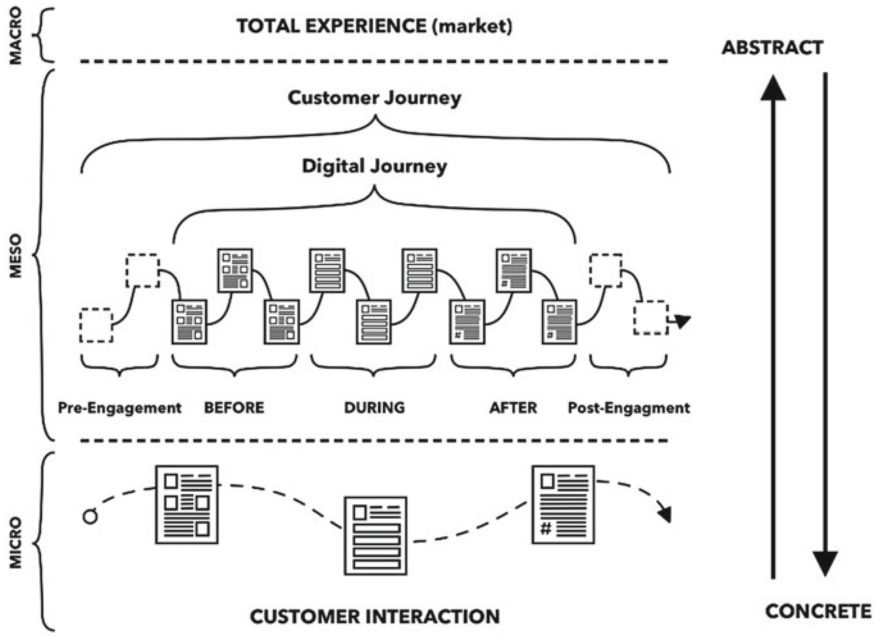

Fig. 1 From user interface to customer experience via the micro–meso–macro layers

with the design of user interfaces. A fundamental component of any information system, by providing a formal way to anchor it to a customer journey and to anchor the journey to the overall experience (Fig. 1).

At the customer interaction level, the micro level, we have the most concrete form of interactions, typically happening between a person and the user interface. One level up, at the meso level, we can characterise the various customer interactions in the form of a single customer journey. A customer journey is a more abstract construct than the individual interactions we have at the micro level, but presents a unified vision that is missing there.

The customer journey is part of an individual's broader experience: at the macro level, that scales to the market, presenting an even greater level of abstraction. In this sense, the customer journey represents the meso elements that sit between the micro (user interface) and the macro (experience).

In a more formalised way, we could represent the different tiers as a hierarchical information model that can be considered analogous to the model of biological organisation and that is based on a series of transformations (Fig. 2).

Data (lowest tier) goes through a first-order level of abstraction and is transformed into information. Information then undergoes a second-order level of abstraction to become information architecture. Finally, a third-order level of abstraction occurs which transforms information architecture into autonomous processes. Each order of abstraction increases the overall abstraction within the system.

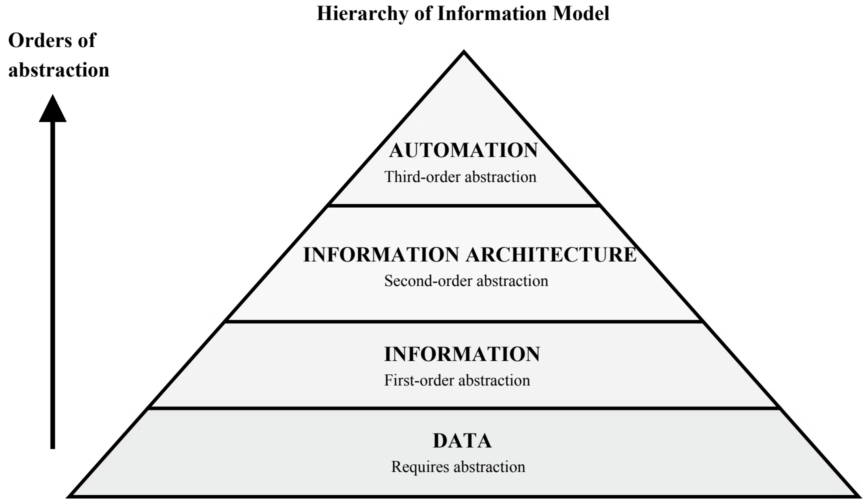

Fig. 2 Hierarchy of information showing increasing orders of abstraction bottom to top

In this model, the customer journey represented in Fig. 1 constitutes a second-order level of abstraction that bridges the customer interaction with the customer experience.

The increase in abstraction that we can observe moving from the bottom to the top of Fig. 2 can also be represented differently by using the micro–meso–macro–meta model (Fig. 3) and a more system-oriented visual approach. In itself,

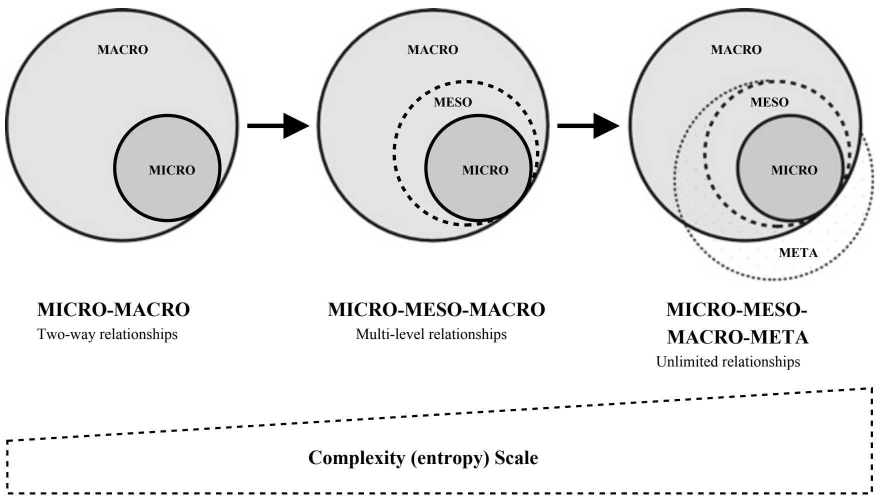

Fig. 3 From micro-macro to micro-meso-macro-meta

the micro–meso–macro–meta model adds one more level of abstraction and therefore increases the potential complexity of the system. Abstraction, and specifically abstract thinking, becomes a mechanism for considering the interrelationships that may exist within a system considered as an information ecology.

Just as the order of abstraction applied to each layer of the hierarchy of information model in Fig. 2 increases in abstraction as we move up, not only does abstraction increase from left to right in Fig. 3, but the total number of interrelationships increases.

The micro–meso–macro–meta model allows the incorporation of data as a layer in its own right, similar to what the hierarchy of information model does (Fig. 2), but it also provides a meta layer that intersects and overlaps with each of the micro, meso, and macro layers. The meta layer increases the total information within the system and consequently also increases the total meta information within the system as well.

The micro–meso–macro–meta model, as well as the hierarchy of information model, relies on the level of analysis framework to examine the interrelationships that can exist within a system by considering them as different levels or orders of abstraction.

Information represents first order of abstraction that provides a bridge for understanding the relationship between data (micro) and information architecture (macro). Furthermore, we can consider information representing a meso layer that allows exploration of the interrelationships that exist as we move from information to data, and, from information to information architecture. Essentially, this means we can observe new interrelationships that exist within an information ecology to better understand the relationships between information structures, enabling better designs that fit with behaviour in more abstract, more generalisable ways than can be considered from a micro–macro approach.

The meta aspect of the micro–meso–macro–meta model is important because it allows the integration into the model of the massive amount of data being generated by the pervasive digital practices of today in "a world which is much more about peer-to-peer sharing and user-generated content", a world in real-time "where traffic directions are instantly provided and groceries are delivered directly to your door" (Schwab, 2016).

Inversion

Inversion started as an in-house conversation at Nomensa in 2013.[1] Changes could be observed in the way we were designing for cross-channel experiences that blended digital technologies with more traditional physical channels.[2] The increased usage

[1] Jason Hobbs, then working at Nomensa, was instrumental in starting and developing the concept.

[2] Cross-channel experiences were first defined in information architecture and user experience in Resmini, A., & Rosati, L. (2011). Pervasive Information Architecture. Morgan Kaufmann. For a

of digital technologies and the proliferation of devices also resulted in increasing channel interactions that produced even greater amounts of data: this data could in turn be used as a feedback mechanism to shape the design experience and the practice of information architecture. What was required was an acknowledgement of the importance of algorithms and algorithmic design, necessary to make sense of massive amounts of data, in the practice of information architecture, and a more precise approach than the micro–macro model could offer.

The micro–meso–macro–meta takes care of handling both the increase in data and the increase in data points because of the multiplication of devices and touchpoints. Combined together, these two create a new design scaling problem which can be addressed by means of inversion, essentially producing a data view of design that can be abstracted into different layers representing the different interrelationships that could (and may) occur.

Where contemporary information architecture as described by Resmini and Rosati (2011) is primarily interested in shifting the focus away from website-only practices and in how digital transformation processes are blurring the boundaries between the physical and the digital environment, wide-scale adoption of digital technologies is also opening up data-based possibilities of intervention that were not there before: for example, we are able to measure how people move around a physical space, whether it is a building or a city, similar to how we measure how people navigate within digital spaces. As such, the primary difference between pervasive information architecture research and practice and inversion as described here is in the type and amount of data they consider and in the change of scale made possible by ML-driven design: an "inverted" view is a data-orientated view.

Inversion suggests that designers should consider this emerging anthropological space (Levy, 1999), in which digital and physical coexist to create new interrelationships that generate massive amounts of data, as being primarily made of data. Rather than taking a top-down approach, designers should take an "inverted" view and think of this space as a space of data flows, exploring and discovering patterns that can shape and influence what is being designed. This also means data and data visualisation become a more explicit method for providing additional and novel feedback.

Inversion is not a new approach: the German mathematician Carl Jacobi[3] introduced inversion as a method for problem-solving over two hundred years ago. In simple terms, inversion requires reversing the classic approach of observing and understanding the effects to determine the cause and starting with the cause to determine the effects. This lack of novelty is a strength rather than a weakness, and such an approach is especially familiar to anyone exploring the application of data visualisation. Specialists in this field amongst other things are examining the data that sits behind the customer interaction (Fig. 2) with the aim of generating new meaning,

more mature conversation on the blending and systemic aspects, Benyon, D., & Resmini, A. (2017). User experience in cross-channel ecosystems. *Proceedings of the British HCI Conference* 2017.

[3] https://en.wikipedia.org/wiki/Carl_Gustav_Jacob_Jacobi.

understanding, and insight, that in turn provides feedback to improve the design of customer interactions.

In its application to information architecture, inversion is proposed as an approach to understanding and applying the massive amounts of data generated to observe existing and new patterns of behaviour. Data visualisation is one of the tools that allow designers to uncover the relationships supporting these patterns and to access the meta layer of the micro–meso–macro–meta model: it therefore becomes a fundamental lens and a key component of the inversion approach to information architecture.

Understanding scale is important, as designers now approach this issue across platforms, screens or interfaces, or even as components of an interface; abstraction increases as the information available is progressively generalised and undergoes order of magnitude changes (Fig. 2). Understanding the relationship between the smaller parts of the design and how that design scales up requires abstract, conceptual, and representational thinking. The levels of analysis framework support the conceptual thinking required to architect systems at scale, whilst the micro–meso–macro–meta model allows designers to identify and understand the system-wide relationships that can be used to create meaning for those interacting with the system.

Conclusions

Whilst we can consider classical approaches to information architecture as primarily top-down, such as a taxonomy providing a structure that allows people to navigate an information environment, inversion is neither top-down or bottom-up. The sheer amount of information available increases complexity and renders both approaches inadequate.

Inversion introduces an entirely different angle based on the application of the levels of analysis framework, that takes into account that what works at a certain scale will not necessarily work at all scales. The micro–meso–macro–meta framework then provides a conceptual methodology to identify and understand the relationships existing in the data at different levels of abstraction, completing the model.

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