Sustaining Requisite Ecosystemic Agility in the face of accelerating demand tempos

Introduction

How does an enterprise create and capture value when the demand tempo, the tempo at which the experiences of its clients need to change, is faster than the tempo at which it can integrate new capabilities within its own organization? This requires a *relational strategy.* The enterprise cannot expect to be able to satisfy on its own the *selective pressure* exerted by the client's expectations. Instead, it must collaborate with other enterprises with whose capabilities it must be able to interoperate at a tempo that is determined by the client's demand tempo, and with whom it forms a supply-side ecosystem.

Digitalisation is not only driving accelerating demand tempos. It is also leading to relational strategies becoming necessary even for a single enterprise, to the extent that parts of the enterprise become equally subject to these demand-side selective pressures. Adaptation to these new kinds of competitive environment leads to the enterprise itself becoming a collaboration amongst its former component parts which themselves become managerially and operationally independent entities – a supply-side *ecosystem* – each entity competing in its own right as well as part of the enterprise as a collaboration.

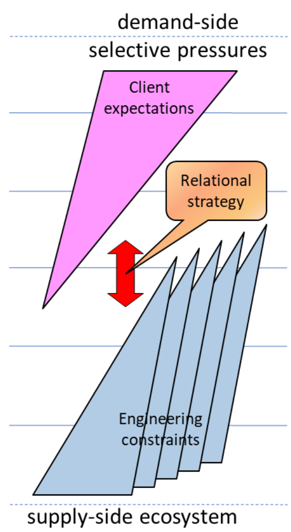

Figure 1: Balancing the capabilities of a supply side ecosystem with demand side selective pressures

This white paper assumes that any managerially and operationally independent enterprise is a *living system* that must sustain a competitive balance between its supply-side and its demand side.[i] A relational strategy enables an enterprise may sustain this balance under conditions of demand tempo accelerating beyond its own ability to integrate new capabilities. This is in contrast to a *positional strategy* in which the demand side is replaced by a market with which it can sustain a one-sided relation. A relational architecture, then, is one that supports a relational strategy. It models the *intelligence* describing the forms of orchestration and synchronisation needed of its own and others' capabilities, along with the *know-how* about the effective use of those capabilities and the relevant *information* and *data* on their necessary performance. This would include the necessary data on their effective delivery into and cohesion within a client's environment in response to a client's expectations. The paper uses two case examples to explore further the nature of the challenge inherent to developing these relational architectures.

The DSS Case Study

The first case study is based on an enterprise (DSS) that made heat-exchangers for jet engines. The proposed strategy was to develop a service proposition that could support the performance of a heat-exchanger for aircraft users throughout its installed life. In order to operationalize this strategy, DSS needed to establish where all the heat-exchangers were that it had sold, how they were being used, by whom and to what ends. On the basis of this information, it could then set about creating a viable commercial strategy for rolling out the service proposition.

In the following mapping of market organization, the colored zones are types of aircraft user, the groupings are of manufacturing consortia, the hexagons identify enterprises and the triangles signify the presence of sales by DSS:

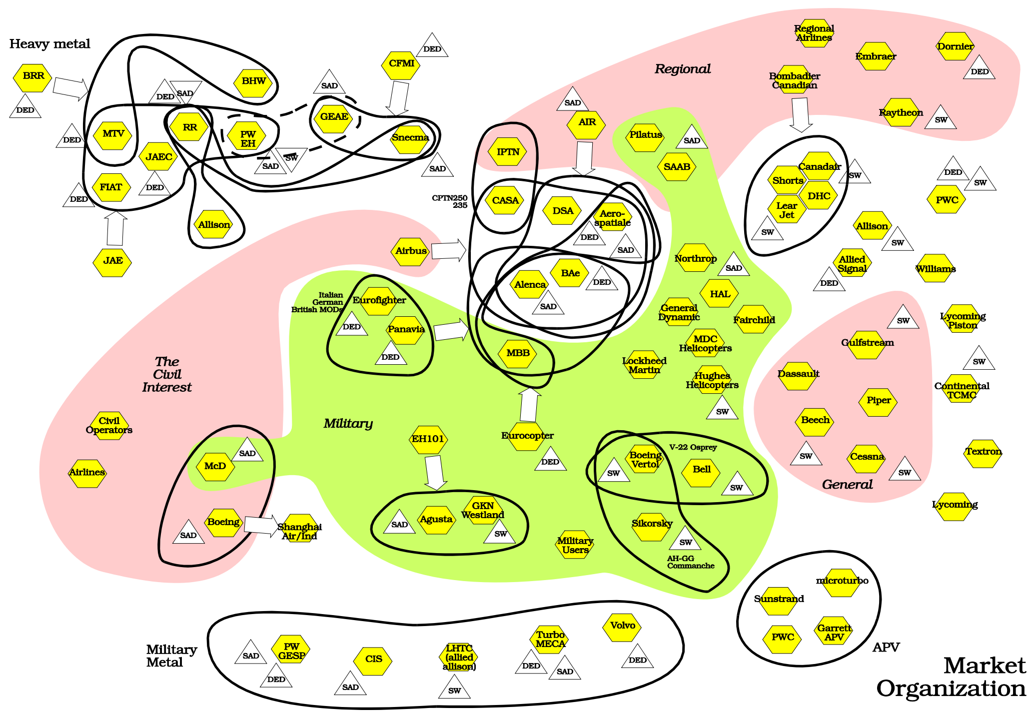

Figure 2: Market Organization

The challenge was to create a digital model that could be used for market-sizing and opportunity targeting, followed by support to the ongoing implementation of the relational strategy. The initial difficulty was that the institutional sources of data on aircraft and on engines each had their own way of organizing their data. This reflected their differing interests in what data they needed to collect and how it was organized. There were two aspects to this difficulty:

- **Ontic granularity**: the *structural model* and *semantics* of each enterprise was supported by an ontic granularity of data particular to the way it made distinctions about its underlying operational reality[ii]; and
- **Hidden variables**: each enterprise had its own way of defining the relevant ontic granularity of data within a *domain of relevance* that underpinned its operational reality . This domain of relevance ignored taken-for-granted *data* that constituted *hidden variables* necessary to relating the ontic granularity of its data to the domains of relevance of other enterprises.

The first step, then, was to develop a structural model of the operational domain in which DSS would be delivering its service proposition.

Structural modeling of the underlying operational domain

The engine and aircraft manufacturers did not provide data on either their end-users or on the way heat-exchangers were being used within aircraft. For DSS, its own sales data could be linked to supply-side data on aircraft and engines. The challenge was to put all the data together in a structural model of what the uses within aircraft might be and of what kinds of use those aircraft were being put to by their end-users. This structural model was necessary to define the service propositions that could support those uses in the aftermarket.

The *pragmatics-of-use* of aircraft users would define the contexts within which DSS could both create value for them and capture value from them.[iii] This in turn would involve DSS developing dynamic supply-side capabilities in two senses. The first of these was by developing “the ability to integrate, build, and reconfigure internal and external competences to address changing business environments” (Teece, Peteraf, and Leih 2016). The heat-exchangers were not only digitalized, however, but digitalization also determined the way heat exchangers performed within their operating environments (i.e., aircraft). DSS therefore also had to develop dynamic capabilities in a second sense. It had to be able to support the dynamic re-configurability of the way its heat-exchangers were delivering their services in real time, matching the demand tempo defined by the varying pragmatics-of-use of aircraft users. The software-intensive nature of this service environment required this dynamic re-configurability to operate at a demand tempo faster than the integration tempo at which its supply-side capabilities could produce and deliver heat-exchangers *per se*[1]. *Dynamic capabilities*$_1$ in the first sense described the level of variability built into the way these supply-side capabilities could interoperate (*aka* a variable geometry-of-use) in producing and delivering heath-exchangers. Dynamic capabilities in the second sense described the further variability required of these geometries-of-use in the way they performed within the operating environments of aircraft users in real time. This meant that this variability had itself to be dynamically reconfigurable in real time (i.e., the dynamic variability in geometries-of-use in the top-right quadrant in Figure 3).[iv]

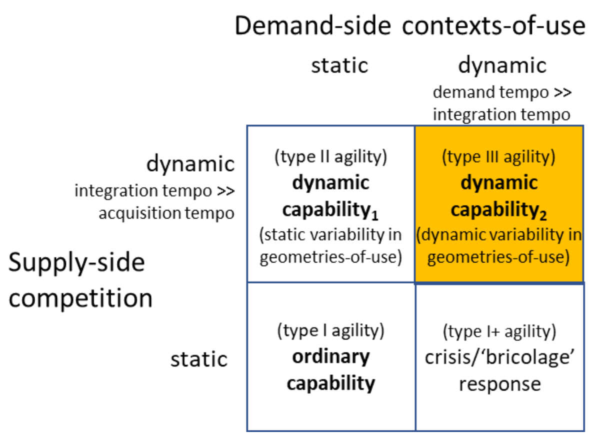

Figure 3: Distinguishing different forms of requisite agility

For DSS to provide an Aftermarket service proposition, it would thus not only have to understand the supply-side characteristics of each of its clients’ aircraft with its subsystems, components and digital configuration. It would also need to be able to track and diagnose the demand-

[1] For example, “the impact of software on the new software-based platform ecosystems for transportation will fundamentally disrupt established companies that viewed software as just another component technology). In actuality, it’s the hardware that becomes just another component. Platform providers may seek to commoditize the hardware platforms through which the software is presented to the user” (Teece 2022).

side condition and performance of the heat-exchangers in each of its clients' aircraft within the contexts-of-use created by aircraft users. The relations between the supply-side and the demand-side of DSS formed a *stratification* (see Figure 4). Its six layers provided a structural model of the operational relation between clients' contexts-of-use and the underlying capabilities necessary to satisfying any one client's pragmatics-of-use.

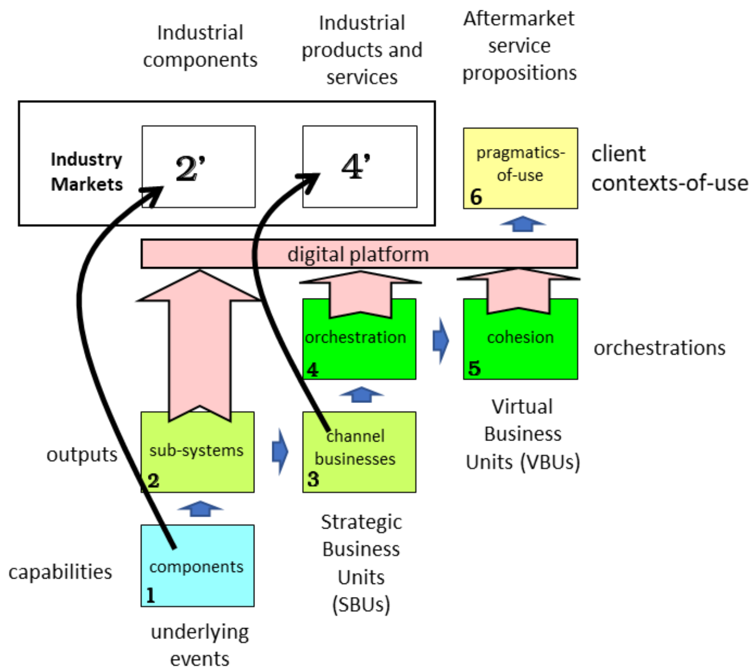

Figure 4: Stratifying the relation between underlying capabilities and context-of-use for DSS

The definition of *markets* depends on abstracting products and services that can be defined independently of clients' demand-side contexts-of-use. The stratification of a structural model brings these demand-side contexts-of-use back into the picture in order to address the particular ways in which 'use' works for each client. Understanding the particular and situated nature of how this 'use-value' works for the client thus forms the basis for creating relational strategies.[v] The 'Russian doll' nature of these relations is because the content of each layer in a stratification is embedded in the layer above it, represented in Figure 4 by the stepwise relation of each matrix to the matrix above it in a series 1 to 6.

For DSS, industrial markets existed for each of these layers as well as there being vertically integrated competitors that spanned multiple layers. What DSS was proposing to do was build a digital model of the relevant content and relations between all the layers for the users of any given client's aircraft based on its structural model. This would provide a basis from which to manage the performance of its heat exchangers within their particular installed contexts throughout the effective life of their use. This digital model had to be able to support an enterprise structural model and semantics for DSS within the domain of relevance necessary to it delivering its Aftermarket service propositions. The difficulties with differing ontic granularities emerged in the course of developing this model.

Ontic granularity

A structural model of the Aftermarket service proposition that DSS wanted to develop required that it be able to dynamically orchestrate and synchronize a distinct digital configuration of products and services for each of its supported heat exchangers within its context-of-use. This operational domain involved the digital orchestration (layer 4) of operational systems (layer 3), making their performance cohere in real time (layer 5) within the client's operating environment (layer 6). In order to do this, it had to balance dynamically the pragmatic constraints from the client's environment (layers 4-6) with the engineering constraints of what was operationally feasible (layers 1-3). The balancing required by this service proposition is represented by the red arrow in Figure 5 representing a *relational strategy*.

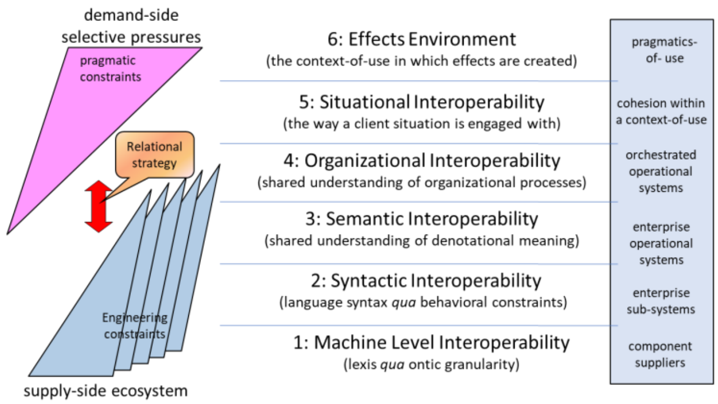

Figure 5: Structural modeling of the relations between the layers in a stratification

The starting point was the data from the industry associations for producers of Aircraft and Engines. The Aircraft data involved identifying *information* (purple key1 in Figure 6) identified by a unique set of relations between *simple data objects*, these simple data objects in this case being the *consortium* that made the aircraft, the airframe *platform* used and the *engine*(s) installed.

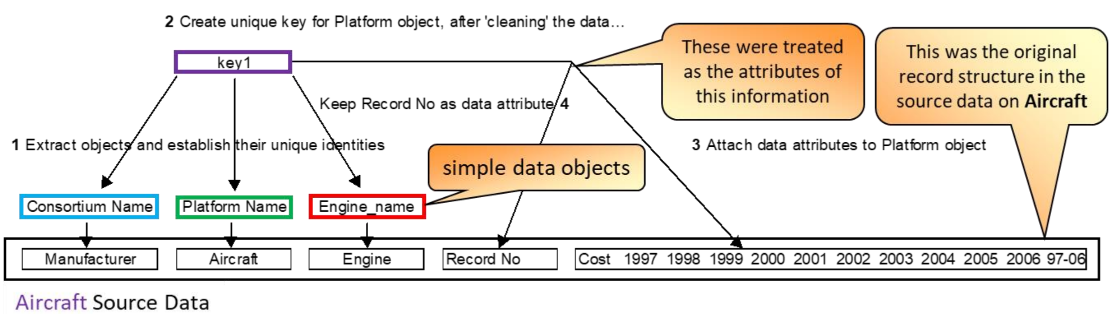

Figure 6: Aircraft Source Data

This information then had to be related to the information identified by the Engine data (orange key2 in Figure 7).

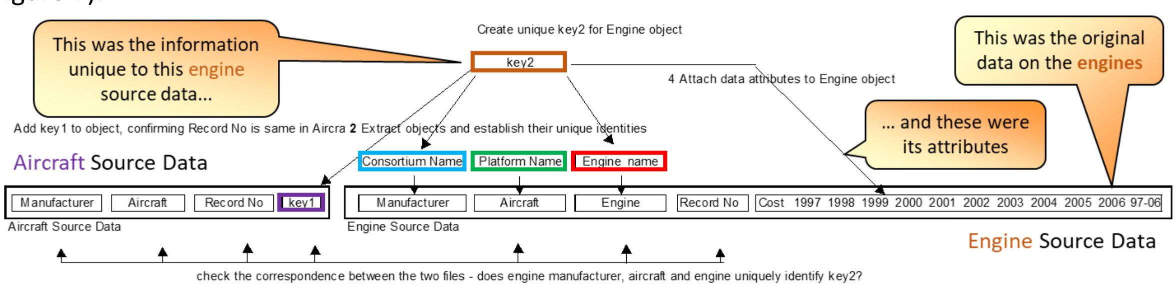

Figure 7: Relating Aircraft and Engine Source Data

This base data could then be related to the data DSS had on the Heat Exchangers it had sold (shown on the right of Figure 8). The service propositions that DSS wanted to provide involved knowing much more about the particular aircraft, their construction and their use. This meant linking this data to the service propositions that DSS was targeting in the relations of layer 5 to layer 6 in Figure 4, represented by the blue box in Figure 8. Linked in this way, different patterns of data linkages could be used to identify different types of Aftermarket service proposition. Before being able to do this, the *ontic granularity* of entities in the structural model needed to be identified and described, represented by the yellow boxes in Figure 8.

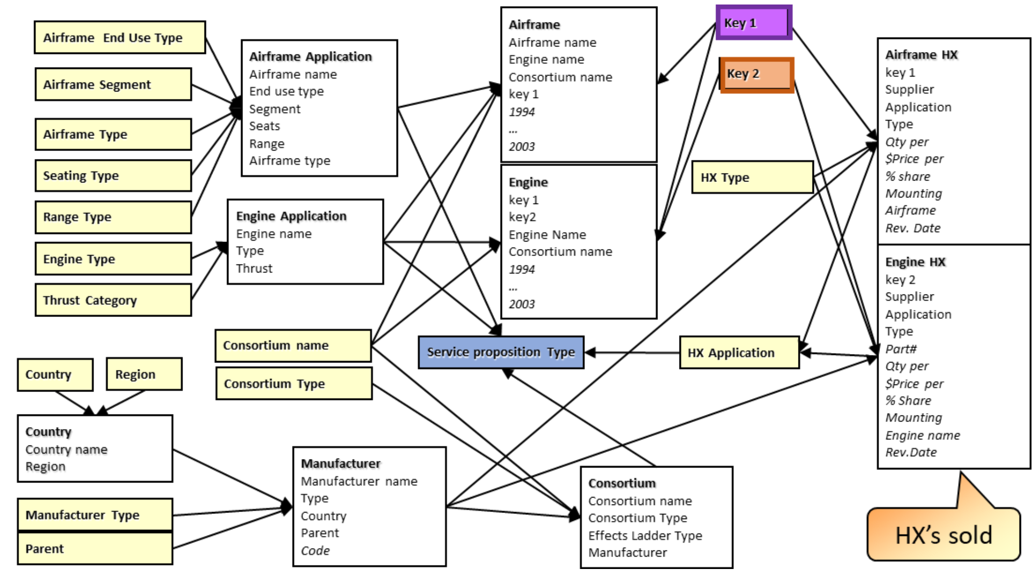

Figure 8: The granularity of the Structural Model

This first case study showed how a relational strategy involved greatly expanding the ontic distinctions needing to be made within DSS's domain of relevance in order to represent value propositions relevant to a relational strategy[2]. The second case study goes a step further in order to capture the relations between different domains of relevance reflecting different kinds of practice[3], introducing the need to identify hidden variables that could enable these relations to be captured. It also introduced a third aspect to the difficulty in constructing a digital model alongside those of defining the ontic granularity of a structural model and identifying hidden variables:

- **Representing *know-how*** about how capabilities in layer 3 could be orchestrated and aligned in layer 4 as composite capabilities appropriate to any one particular context-of-use in layer 5. For DSS, this meant being able to represent know-how about reconfiguring the way a heat-exchanger was able to perform dynamically within a particular client's operating environment through determining the way it could interoperate with other capabilities. In this next case study, this meant being able to represent the different ways in which clinicians treated the particular conditions of a patient.

[2] Even though patterns of data linkage in Figure 8 enabled different kinds of know-how to be described, the keying of this data into specific client environments has not been shown. The challenge this represents is taken up in the next case study.

[3] A domain of relevance is particular to the way an enterprise has chosen to compete, different clinicians' practices thus being the equivalent of an enterprise in this case study.

The Orthotics Case Study

The second case study involved working with Orthotics Clinics operating within an Acute Trust of the UK's National Health Service (NHS), funded partially by its local community via a Primary Care Trust (PCT). In addition to improving the performance of the clinics as part of the Acute Trust, the project was to improve the quality of chronic care provided to an aging population[vi].

The challenge of managing the treatment of chronic conditions was that it involved the clinician making 'investment' decisions in the present about treatments that anticipated their future effects on the through-life condition of the patient. This was necessarily a clinical judgement involving clinical know-how, but the challenge was in finding a way to hold the clinician accountable for the relation between the through-the-life-of-the-condition costs of treatment and the patient's quality of life. It was impossible to hold a clinician accountable for the outcomes with each individual patient because of the essential unpredictability of individual outcomes over an extended time period. It was possible, however, to hold a clinic accountable over numbers of such patients by examining patterns in the tradeoffs that could be tracked between treatment costs 'now' against treatment costs 'later' for any given condition, costs relating to both healthcare and social care, such that the through-life costs were lower while quality-of-life was better.

The following table summarises how the requirements of chronic care differ from those of Acute and Primary care:

Table 1: Distinguishing Chronic care from Acute and Primary Care

		Acute Care	Primary Care	Chronic Care[+]
Periodic analysis of costs aggregated by treatment	Patient	Health Resource Groups aggregated across patients for different kinds of condition ✓	Primary care costs aggregated across patient numbers adjusted demographically ✓	Primary care costs aggregated across patient numbers adjusted demographically ✓
	Multiple services	Role of support services subordinated to requirements of acute role as part of the overheads ✗	Primary Care Trust (PCT) has to provide a range of services that can be combined as appropriate in response to the patient ✓	PCT has to provide a range of services that can be combined as appropriate in response to the patient ✓
+ Through-time analysis of whole-life costs of treatment*	Episode series	Not relevant ✗	Repeat episodes are not tracked ✗	Characteristics of the episode series becomes a fundamental determinant of total cost of treatment ✓

* Present judgement of episode-defining condition is not independent of anticipated future consequences – i.e. there is some measure of 'investment' in current treatment in the sense that it will affect the nature (and therefore cost) of future treatments.

The table identifies the importance of tracking the characteristics of episode series for a patient in order to be able to evaluate the performance of a clinic over a population of patients. This, or course, is the necessary condition for being able to fund a clinic to pursue these kinds of outcome.

A clinician pursues a relational strategy in treating individual patients' conditions. In terms of the stratification in Figure 9, whether the clinic is part of Acute or Primary care facilities, its role was in layers 4 or 5 respectively, orchestrating treatments or delivering episodes of care. What made chronic care different was the need to manage multiple episodes of through-the-life-of-the-condition care in layer 6. The challenge arose because the Acute system was just funding the availability of treatments and the PCT funding was just focused on providing single episodes of care subject to annual budgets. This made it possible to aggregate across patients within the PCT's catchment, but not to aggregate across time and across different kinds of budget, i.e., across both healthcare departments and across transportation and social care budgets. The challenge was therefore to provide the means of doing this for PCTs and their Acute Trusts by being able to track through-the-life-of-the-condition treatments across multiple episodes of care for patients.

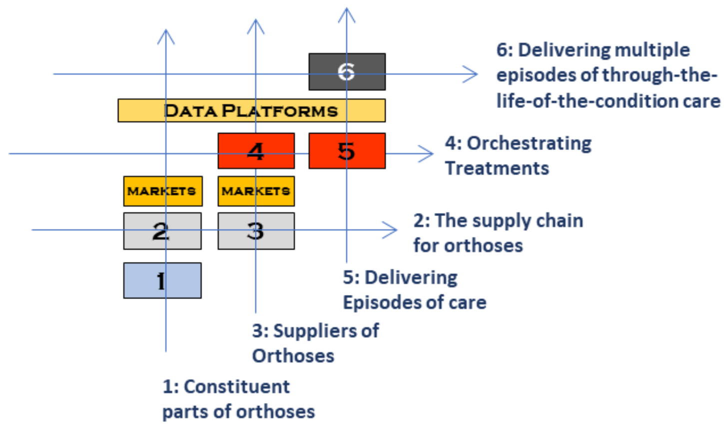

Figure 9: stratifying the relation between underlying capabilities and context-of-use for Orthotics

Modeling Know-how

An examination of the relevant information systems that had a bearing on tracking episode series revealed four kinds of siloed operational systems, each with its own supporting information system. Relating the information in these silos to the episode characteristics needed for a patient depended wholly on clinicians' judgements based on their know-how (see Figure 10).

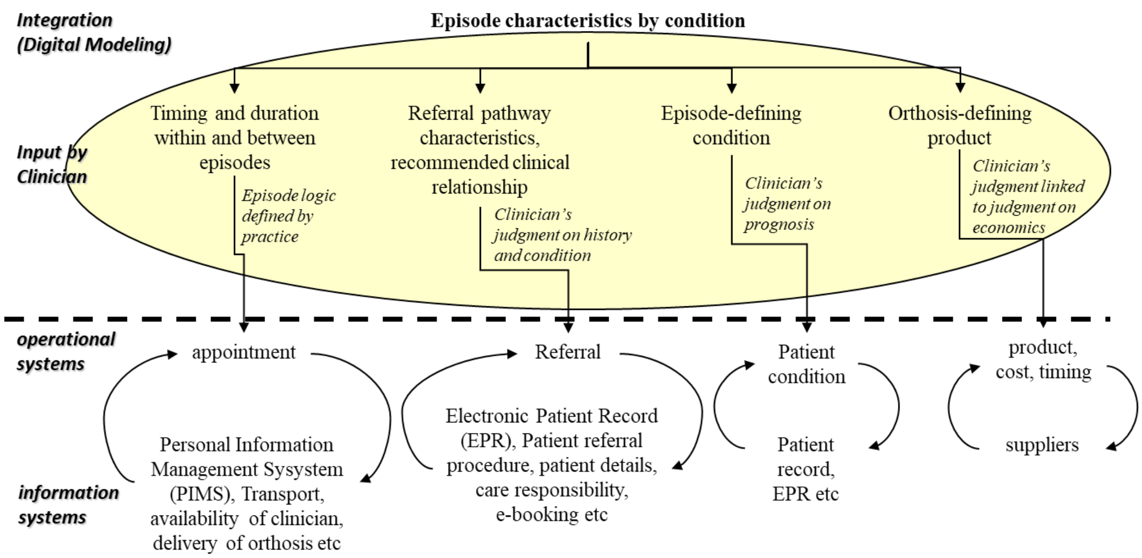

Figure 10: The clinician's know-how relating to episode characteristics by patient condition

Providing digital modeling in support of the clinician's structural role in Figure 9 meant providing a way of representing know-how as it related to the situations of patients. Evidence of the use of this know-how was partially on paper in clinicians' patient notes and partially in clinicians' heads. Modeling these know-how relations was necessary to 'joining up' the information in the operational systems under the dotted line in Figure 10. These information silos defined information, i.e., *dyadic* relations of varying complexity between *monadic* individual pieces of data. In contrast, these know-how relations involved *triadic* relations in which the nature of relevant information was contingent on the simultaneous presence of one or more other types of information.[vii]

So for example, the treatment for scoliosis (below the solid line in Figure 11) in the context of a patient's spinal pathology (above the solid line) would involve a different treatment strategy than that needed if the context was a neuro-muscular disorder. Conditions above the solid line were *root cause conditions* that were systemic in nature, predictive of the potential presence of one or more 'ontic' conditions that form within the context of the given 'root' condition, while conditions below the line were *'ontic' conditions*[4] at the most disaggregated level that were symptomatic of those root cause conditions[viii].

To provide the means of tracking performance across multiple episodes of care, however, the clinicians had to record not only these root cause and 'ontic' conditions for each patient but add the patient's *senior condition*. This was the clinicians' judgement of the condition that best characterized the prognosis at the time of the judgement for how the patient treatment would unfold over multiple episodes. Examples of the way clinicians distinguished root cause conditions above the solid line in Figure 11 reflected the fact that different clinics faced different populations with different combinations of 'ontic' condition, so that these high-level descriptors emerged for a clinic as a useful way of tracking the patterns in outcome over multiple episodes for their kinds of patient. This idiosyncratic use of high-level descriptors was therefore 'triadic', necessary to peer review processes within the clinic so that they could be based on an agreed way of comparing episode series for applying their know-how to senior conditions.

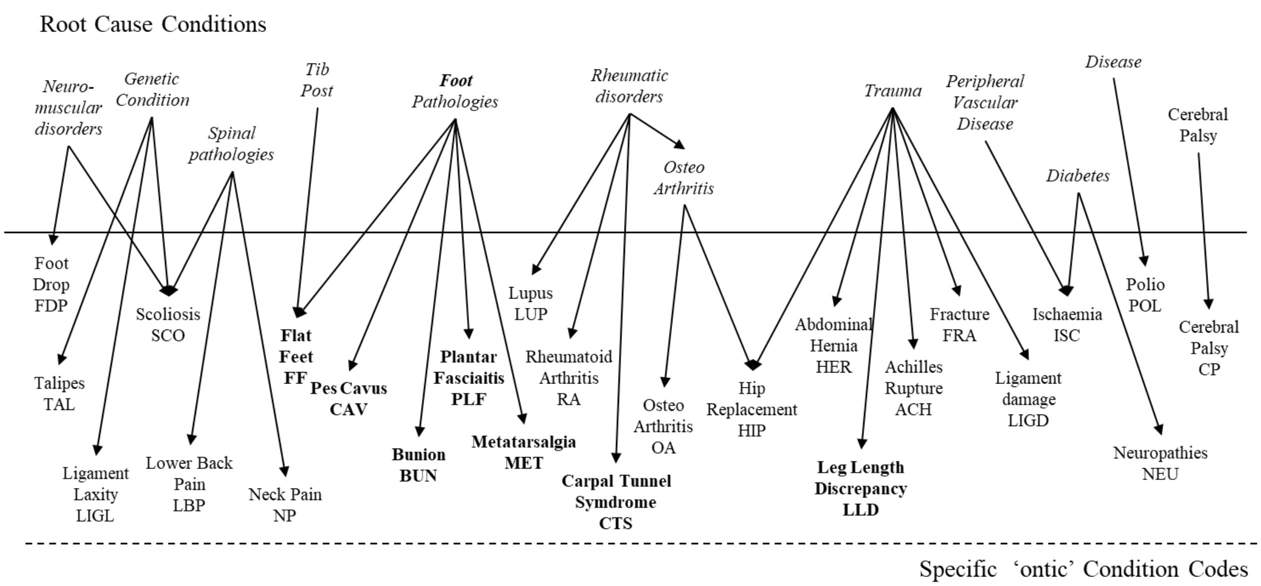

Figure 11: Distinguishing Root Cause Conditions

In contrast, the clinicians' ways of distinguishing types of orthosis above the solid line in Figure 12 were more open to agreement based on the orthotist profession, although even here there were likely to be differences because of the way the underlying products were changing. The way orthotists related conditions to orthoses, however, was another 'triadic' relation reflecting the clinician's clinical judgement of what forms of treatment would be effective.

[4] The word 'ontic' here is being used as a special form of ontic granularity, based on the direct observation and/or measurement of some aspect of the patient's condition i.e., a 'monadic' data point. Any one patient may well have more than one root cause condition and potentially very many 'ontic' conditions.

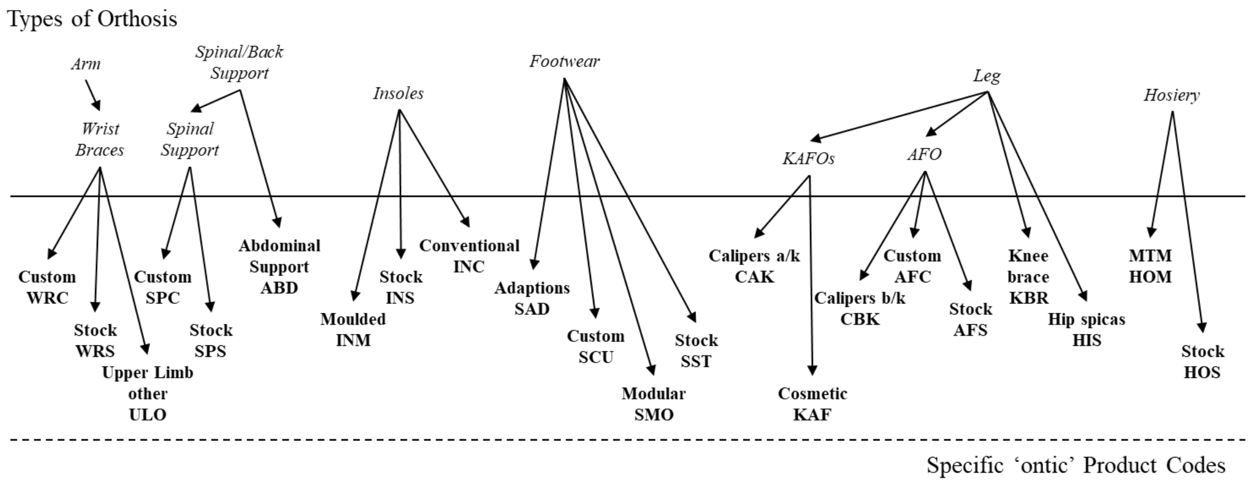

Figure 12: Types of Orthosis

The digital modeling of clinicians' know-how was thus captured by these agreed-upon high-level characterizations of condition and orthosis as they related to the patients, reflecting agreement established through peer review processes within the clinic. [ix] This agreement over what constituted senior conditions and what were effective treatments enabled high-level reports to be generated for the clinic enabling clinicians to review outcomes. It also provided the basis on which a different approach became possible for funding the clinic. Figure 13 summarises the different kinds of outcome reporting that became possible.

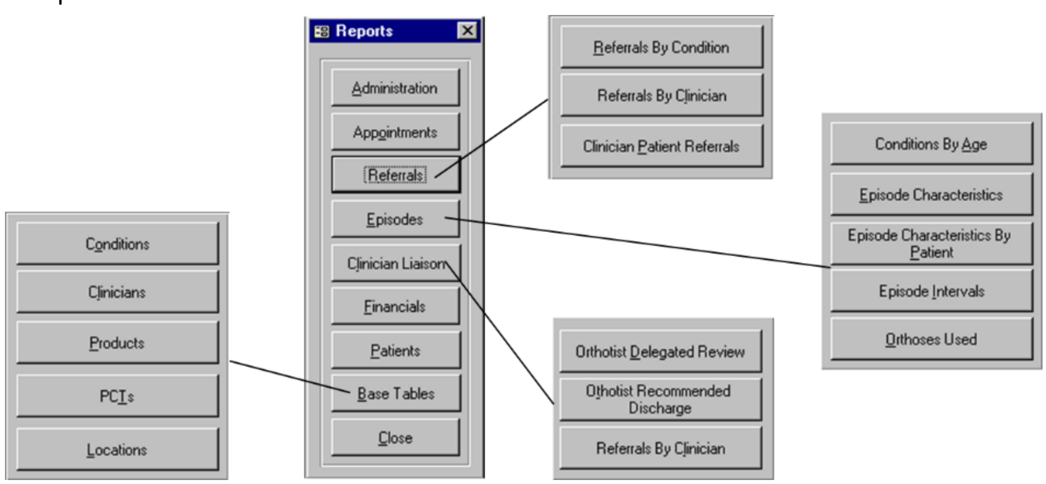

Figure 13: Output reporting by clinic

Hidden variables

Below the dotted lines in Figure 11 and Figure 12 were coding systems used by other clinicians to capture data on patients, conditions and treatments. These coding systems were used idiosyncratically by clinicians in other clinics to capture ontic data relevant to their clinical practices. When treating a patient delegated to an orthotics clinic from elsewhere, therefore, knowing where and by whom the patient had been treated was important in interpreting available information on the patient. The data encoded in the information system silos was also at a level and of a type that frequently had no relation to the ontic distinctions that the orthotists were needing to make. In order to map parts of their know-how onto that of the orthotists, therefore, it was necessary to look for hidden variables. Thus, a piece of data not relevant to a surgeon might be crucial to establishing the nature of a patient's condition from an orthotist's perspective, and vice versa in enabling the surgeon to judge a successful outcome.

The ways in which know-how relations were formed varied not only by clinician within clinic but also across clinics. To compare multi-episode outcomes across clinics, therefore, their different ways of characterizing the relations between patients, conditions and orthoses had to be mapped onto each other. This involved cross-referencing the different ways of characterizing root causes and types of orthosis by reference to the underlying ontic distinctions they referenced. This again involved identifying hidden variables that became necessary when making these mappings.

Twinning a digital model to a structural model

The structural modeling relation is thus, in the first instance, a way of speaking about the strategy of an enterprise[x]. It describes the way an enterprise (or clinic) intends to create and capture value for its clients and patients within the context of its competitors and suppliers. A relational strategy addresses the demand-side selective pressures in relation to which the enterprise is seeking to create value. It has to balance these with the need to capture value for the supply-side ecosystem, given the way it is creating value. This capturing of value is based on three kinds of economies that it can offer the client or patient: the familiar supply-side *economies of scale and scope*, to which relational strategies add *economies of alignment*. These latter involve orchestrating and synchronizing capabilities of a supply-side ecosystem that manages externalities, reducing the cost of and improve the quality and cohesion of the client's or patient's experience.

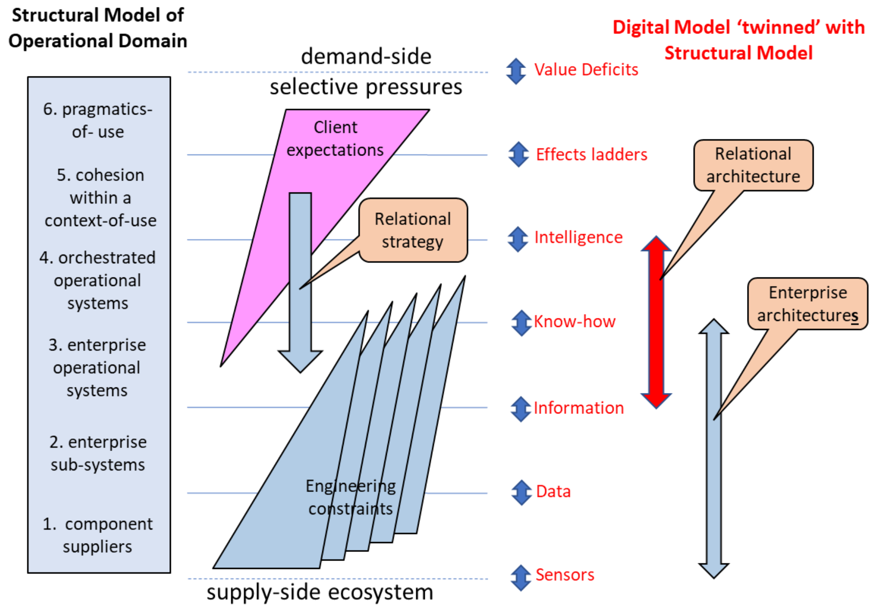

Figure 14: The role of relational architecture

If the structural layers in Figure 14 are looked at from the perspective of management (clinician and PCT) wanting to know if their strategy is succeeding, then it will need digital modeling of the relations between these layers (see also Table 2[xi]). Building such a digital model involves 'twinning' it with a structural model of DSS's (or the clinic's) operational reality. A 'twinned' digital model for the relations between layers 1-3 in terms of sensors, data and information is relatively familiar to an enterprise architect, being about generating information supporting layer 4 capabilities (as described below the dotted line in Figure 10). Particularly challenging, however, is bringing the digital modeling of the know-how relating layers 3 and 4 into relation with the relation of layers 4 and layer 5. The Orthotics case study showed how modeling know-how involves modeling the changeable variety of ways in which operational systems may be orchestrated. Modeling intelligence then involved capturing the senior condition representing the clinician's judgement over what would be determining of the multi-episode outcome. The Orthotics case study showed the particular challenges of developing a relational architecture that could model the relations between information, know-how and intelligence in support of the clinic's relational strategy.

Relational Architecture

The modeling supported by the relational architecture started from the *effects* that DSS wanted to have on a client's pragmatics-of-use (the 5-6 relation *aka* the impact on the patient's through-life condition), a pragmatics that would be driven by the client's relation to an experienced *value deficit* (the 6-7 relation being the patient's experience of what remains 'wrong'). Establishing this would lead to having adequate *intelligence* on what DSS needed to make happen for the client (the 4-5 relation or the clinician's diagnosis of what treatment the patient needed).[xii] Such intelligence could only be of use, however, if supported by the necessary *know-how* (the 3-4 relation or what possible treatments the clinician judges there might be that would impact on the patient's condition) supported by *information* (the 2-3 relation or what is currently known about the patient, condition and treatments), which in turn would be based on *data* (the 1-2 relation or data from diagnostic tests) sourced from the relevant *sensors* (the 0-1 relation to operational reality). The requirement for a relational architecture was thus to develop the digital model necessary to providing DSS (clinics) with this intelligence-know-how-information relation from which the efficacy of relational strategies could be judged.

Table 2: Modeling the relations between the layers of a stratification

Structural Model	Digital Model	Relevance to Structural Model	Type of Knowing[5]	Description of form taken by digital model
Layers 6-7	Value deficits	Demand Situations	Know-Why	lacks/gaps beyond experienced effects
Layers 5-6	Effects			effects ladders modeling 'contexts-of-use' within problem domains
Layers 4-5	Intelligence	Customer Situations	Know-for-Whom	forms of synchronization/cohesion satisfying particular (in)vested interests (i.e., 'intelligence' *aka* military intelligence)
Layers 3-4	Know-how	Relation patterns between complex object relations	Know-Who	object-referenced c-type value propositions that are triadic patterns in the relations between complex object relations
Layers 2-3	Information	Complex object relations	Know-How	invariance and concurrency of dyadic relations between simple data object relations
Layers 1-2	Data	Simple data object relations		dyadic relations of the form <object A><relation><object B>
Layers 0-1	Sensor outputs		Know-What	monadic observations of traces left by things happening

One approach to this is to impose a single architecture across the whole ecosystem of enterprises. Although in principle possible[xiii], in practice this is both very difficult and very time-consuming to realize. It depends on standardizing the digital modeling of the bottom three layers of the

[5] Taken from 'A Knowledge Taxonomy for Army Intelligence Training: An Assessment of the Military Intelligence Basic Officer Leaders Course Using Lundvall's Knowledge Taxonomy' (Ruiz 2010). 'Know-who' here means knowing who the enterprise is going to be for the client – a one-sided relationship – whereas 'know-whom' means knowing for whom in particular the value proposition is creating value, thus addressing the multi-sided nature of the client's situation.

operational domain in Figure 14, itself based on a presumption that the top three layers can be replaced by a market. This was the approach adopted by CORBA services.[xiv]

The alternative is to adopt a relational approach which, instead of standardization (the 2*-3-2* arrows in Figure 15), focuses on the particular forms of interoperability needed between operational domains. In practice, this means

- identifying the target structural model for the relational strategy (as in Figure 4) that defines the relevant ontic granularity; then
- identifying the corresponding aspects of the structural models for operational domains with which it needs to interoperate (the '1' arrows in Figure 15).
- From these structural models, the twinned digital models that are needed can be identified (the 2 relations in Figure 15).
- This will need to include the triadic know-how relations that will be needed to span the variety of effects being targeted by the relational strategy.
- The difference between 2* and 2 will then identify the hidden variables needing to be added.

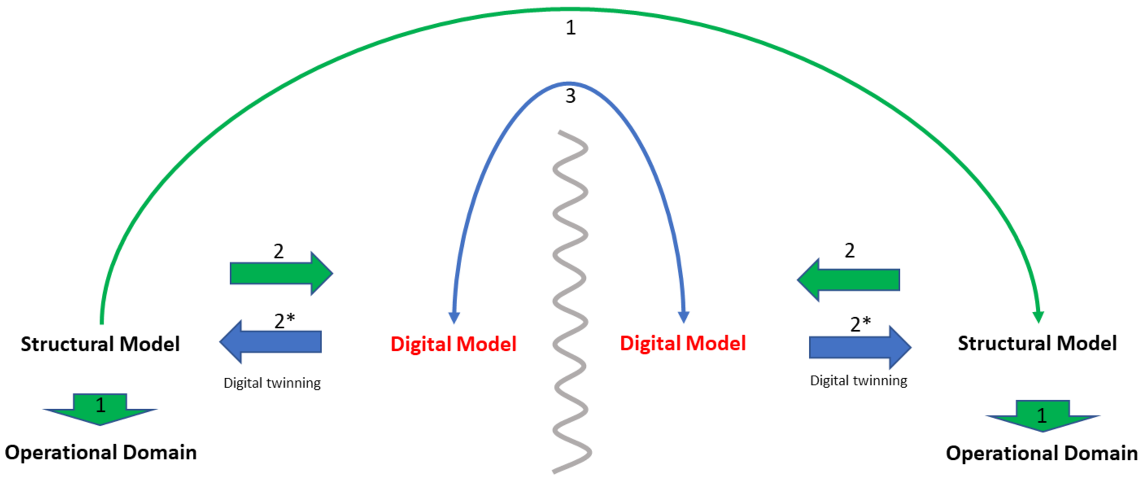

Figure 15: Identifying hidden variables

In conclusion

It is not possible to create a universal digital model of the know-how relevant to creating value in terms of a client's pragmatics-of-use. It has to be done in particular in the form of a triadic relation between what are themselves three kinds of structural modeling that come together as the layers of a structural model of the operational domain supporting that creation of value:[6]

1. Structural modeling of the *behaviors* of which technologies and engineering are capable (knowing the 'what' and 'how' of task systems).
2. Structural modeling of the *organization* of the ways technologies and engineering may be used as value propositions (the domain of relevance derived from knowing the 'who' and 'for whom').
3. Structural modeling of the *pragmatics-of-use* (i.e., effects ladders) driving the way value propositions are used with particular contexts-of-use (knowing something of the client's 'why').

This involves adopting an approach to structural modeling that is *triply articulated*.

[6] This three-way modeling (and the relations between them) is consistent with the approach used by the intersection group: 1. Architecture; 2. Identity; and 3. Customer experience.

It is not possible to create a universal digital model because the domain of relevance is different for each value-creating relationship in a relational strategy. The consequence of this is to have to distinguish in each case

- the ontic granularity of the structural model of the operational domain and
- the particular triadic forms of know-how necessary to delivering value.

Given that each collaborating enterprise will have its own ways of defining its domain of relevance, this will further mean

- identifying the hidden variable that have to be made explicit in order for different domains of relevance to be brought into relation with each other.

Methods for modeling these three things (ontic granularity, triadic know-how and hidden variables) are necessary to creating a relational architecture capable of supporting a relational strategy.

Glossary

demand-side
- $_1$**selective pressures** – the demand-side drivers shaping the nature of the client's expectations within its context-of-use. 1
- **client pragmatics-of-use**
  - – the use to which a product or service is put by a client within that client's operational context..... 3
  - **context-of-use** – the operational context within which a product or service is used by a client. 3
- **condition**
  - **'ontic'** - conditions at the most disaggregated level that were symptomatic of those root causes. . 10
  - **root cause** – a condition that is systemic in nature, predictive of the potential presence of one or more 'ontic' conditions that form within the context of the given 'root' condition. 10
  - **senior** - the clinicians' judgement of the condition that best characterized the prognosis at the time of the judgement for how the patient treatment would unfold over multiple episodes. 10
- **market** – the abstracting of products and services that can be defined independently of its clients' demand-side contexts-of-use. 5

digital model
- $_1$**simple data object** – data corresponding to a uniquely identifiable (monadic) data object. 6
- $_2$**information** – information in the form of a unique (dyadic) set of relations between simple data objects. 5
- $_3$**know-how** – a (triadic) patterning of relations between complex object relations that are themselves patterns of relation between simple data objects (i.e., between different kinds of information) representing how capabilities in layer 3 could be orchestrated and aligned in layer 4 as composite capabilities appropriate to any one particular context-of-use in layer 5. 7
- **relation**
  - $_1$**monadic** – the ontic assertion of an individual piece of data established through the act of naming. 9
  - $_2$**dyadic** – information formed from patterns of multiple relations between simple data objects, each one of the form <A><relation><B>. 9
  - $_3$**triadic** – the nature of a relation that is itself dependent on the simultaneous presence of one or more other types of information *qua* presence of one or more different kinds of pattern in the relations between simple data objects. 9

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Additional Notes

[i] A living system (Rosen 1991) is one that sustains a dynamic operational closure between four distinct kinds of process:

- Selection of demand-side value created
- Repetition of a temporally isolating boundary
- Maintenance of its current form
- An enabling supply-side transformation

There are four distinct ways in which this dynamic operational closure may be held. These correspond to the four forms of competitive dominance within a business ecosystem (Boxer 2011), which parallel the four to be found within a biological ecosystem (Kineman 2018).

[ii] The approach to the structural model underpinning the behavioral semantics of an enterprise is that it is particular to the enterprise, being rooted in its practices. The assumption is thus "… that *ontology* is not given in the order of things, but that, instead, *ontologies* are brought into being, sustained, or allowed to wither away in common, day-to-day sociomaterial practices…" [italics in original] (Mol 2002: p6)

[iii] Placing an emphasis on the clients experience (CX) through the life of the exchange with the supplier adds a third dimension to the other two of the identity of the enterprise and of its task-system architecture (see https://intersection.group/tools/edgy-language/). This means that the modeling relation has to be triply articulated.

[iv] Dynamic capabilities of the first kind were thus first-order, enabling choices over which capabilities could be made to interoperate with which other capabilities. Dynamic capabilities of the second kind were second-order, enabling choices to be made over *how* these first-order choices of interoperability would interoperate in real time.
[v] The value of Mols' work (Mol 2002) is in establishing the importance of focusing on the demand-side *practices* of the client-patient and in examining the impact this has on the ways in which we understand structural model.
[vi] Using USA data, Chronic conditions are defined as illnesses that last longer than 3 months and are not self-limiting. They are the leading cause of illness, disability, and death in the USA, and affect almost half of the U.S. population. Thus about 1 in 6 Americans is limited in daily activities in some way as a result of a chronic condition. Disabling chronic conditions affect all age groups; about two-thirds of those with such conditions are under age 65. The majority of health care resources are now devoted to the treatment of chronic disease. In 1990, the direct medical costs for persons with chronic conditions was nearly 70 percent of all personal health care expenditures. (Committee on Quality of Health Care in America 2001)
[vii] A functor is a mapping between categories, a category (*aka* abstract category) being a collection of objects that are linked by arrows. Within the PAN toolset, a category in this sense is a complex object identifying information defined in terms of dyadic relations (arrows) between the simple data objects appearing in a visual PAN model. Value propositions that relate the capabilities of an enterprise to the situations of clients represent particular ways of using those capabilities (*aka* know-how) which are described in PAN as types of restriction placed on the relations between complex objects (*aka* categories). Value propositions are thus themselves adjoint functors (see John Baez on higher-dimensional categories https://math.ucr.edu/home/baez/week77.html#tale).

The restrictions defining these adjoint functors that represent know-how *qua* value propositions correspond to Peircean thirdnesses, making these value propositions *triadic* in nature (see evaluating architectures). For the relevance of these triadic relations *qua* adjoint functors to demand asymmetry, see also https://asymmetricleadership.com/2011/07/28/a-categorial-expression-of-demand-asymmetry/
[viii] Special thanks are due here to Cheryl Clark BSc(Hons) Prosth &Orth MBAPO, Senior Orthotist at King's Healthcare, who identified the need to separate the lowest and highest (root cause) levels of description from the senior condition determining the characteristics of subsequent episodes.
[ix] Mol's book (Mol 2002) is full of examples of these differences in what is judged relevant from the perspective of both different clinicians and also patients and their families. This goes as far as requiring us to think not of our bodies not as a single body but as multiple bodies.
[x] For more on this, see https://asymmetricleadership.com/2022/11/17/the-relationship-of-conceptual-or-structural-modeling-to-other-types-of-modeling-approach/
[xi] The link to military intelligence thinking is through the Aristotelian four causes (Ruiz 2010; Lundvall and Johnson 1994): Know-What: sensors; Know-How: data and information; Know-Who-for-Whom: know-how and intelligence; Know-Why: effects and value deficits.
[xii] The placing of 'wisdom' in the intelligence layer normalizes something that needs to be *relative* to desired effects. This normalization renders the DIKW relations hierarchical, whereas they are in practice a stratification, the form of which depends on its relation to vested interests and desired effects. See (Weinberger 2020) for a critique, but also Actor Network Theory for an understanding of stratification (Latour 2005).
[xiii] In principle possible if a one-sided relation to demand can be assumed, expressed in terms of markets. This becomes impossible in practice when the value being captured by an enterprise is based on the indirect effects of its value propositions within a client's context-of-use. See https://asymmetricleadership.com/2022/11/17/evaluating-architectures/
[xiv] What is at stake here is the ability to define an structural model purely in terms of syntactical level definitions of its objects. See 'The Rise and Fall of CORBA' https://queue.acm.org/detail.cfm?id=1142044, but also the response: http://www.dre.vanderbilt.edu/~schmidt/corba-response.html