Visserian Metaphysics

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This article characterizes what we call Visserian Metaphysics. Visserian Metaphysics follows from a number of works in the area of architectural design of distributed systems developed and/or supervised by Chris Vissers throughout his career [4, 13, 14, 16, 18, 26]. We make explicit some of the ontological commitments of Visserian Metaphysics discussing how behavioural and structural aspects of a system are related in this line of thought. Our analysis of the relation between behavioural and structure aspects of a system leads to the notion of Visserian Creatures, which have remained undiscovered in Visserian Metaphysics until the present article. An epilogue tries to explain the existence of Visserian Creatures in Visserian Metaphysics from an art-theoretical perspective.

1. Introduction

The area of architectural design of distributed systems is the area of the design of any possible system that can be decomposed into interacting parts. Examples of such systems are: a bike, which is, among other things, composed of paddles that interact with a wheel to generate motion [24]; a flock of sheep, which is composed of a number of sheep where we can abstract from the exact number of sheep and the colours of the sheep [3]; and telematics systems [24].

Since not all such systems just grow on trees, so to speak, we may have to develop them from an initial idea of the system. In architectural design, this initial idea leads to a highly abstract system design. The designer gradually introduces implementation details into that design until it contains such detail that the parts composed indeed do grow on trees (or can be created by God or mythical entities such as "the environment").

To construct these designs, a designer requires *concepts* that represent the properties of the system at the different levels of abstraction at which the system can be considered throughout the design process. *Basic design concepts* represent the common and essential properties of distributed systems at the different levels of abstraction. Such common concepts are especially necessary to relate the various levels of abstraction of distributed systems design (as defended in [2]).

Such basic concepts have been developed in [4, 13, 14, 18, 26], under the umbrella of what we call here Visserian Metaphysics. In this paper we discuss the implications of the choice of basic design concepts for Visserian Metaphysics.

This paper is organized as follows: section 2 provides some background on the basic design concepts that underlie Visserian Metaphysics; section 3 makes explicit some of the ontological commitments of Visserian Metaphysics, characterizing it as a type of Nomological Essentialism; section 4 discusses how behavioural and structural aspects of a system are related in Visserian Metaphysics; section 5 discusses the implications of the relations between behavioural and structural aspects, which leads to the notion of Visserian Creatures. An epilogue tries to explain the existence of Visserian Creatures in Visserian Metaphysics from an art-theoretical perspective.

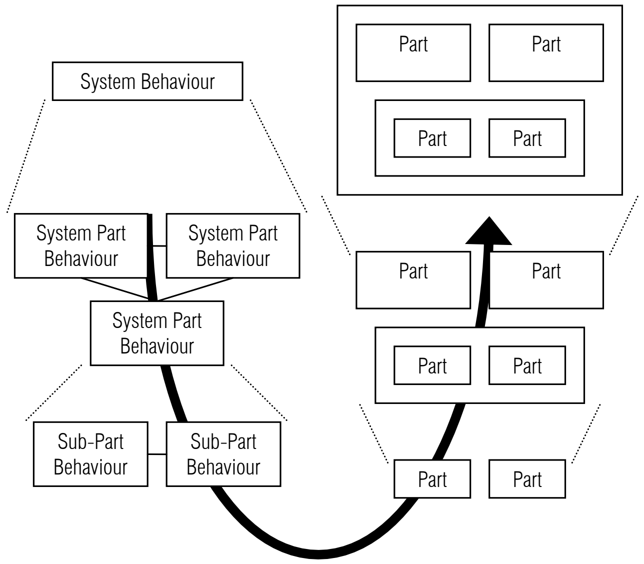
2. Basic Design Concepts

A system is a "*regularly interacting or interdependent group of items forming a unified whole*" [11]. This definition reveals two important perspectives on distributed systems design: the *internal perspective*, in which we consider the system as a group of items, and the *external perspective*, in which we consider the system as a whole. The system as a whole and each of its individual parts perform a behaviour. A behaviour is a collection of activities and relations between those activities. One should not think in terms of "little machines"[1] that just happen to collaborate when considering those behaviours [3]. Instead, one should think of a behaviour that the designer prescribes and that, in some way, must be performed by the system. Hence, behaviour is paramount when designing a distributed system. The structure must be constructed to support that behaviour. This leads to the "U" of distributed systems design, illustrated in *Figure 2-1*. The "U" illustrates that first a

[1] From Dutch "machientjes"

system's behaviour is designed in several steps and then the system is constructed from parts that support this behaviour.

Figure 2-1 The "U" of Architectural Design



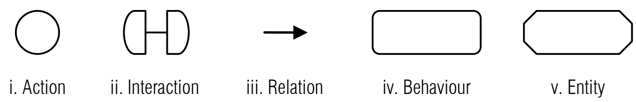
Concepts that support the design of distributed systems should be derived by careful analysis of the domain and meet the criteria described in [25]. Formal description techniques purely based on mathematics most certainly do not meet those criteria. Hence, we should develop our own design concepts. These concepts should be *precise*, but not formal; *parsimonious*, but not formal; and *generally applicable*, but not formal.

Investigating the domain of distributed systems design as explained above, the following basic concepts have been derived:

- action: the successful completion of an activity performed by a single entity;
- interaction: the successful completion of an activity performed by some entities in collaboration;
- relation: a causal relation between activities;
- behaviour: a collection of activities and their relations; and
- entity: a physical (most certainly not logical) carrier of behaviour.

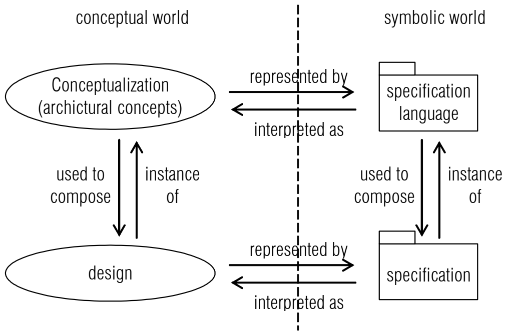
These concepts are discussed in more detail in [4, 13, 14, 18]. *Figure 2-2* illustrates how these concepts can be represented graphically.

Figure 2-2 Graphical Representation of Basic Design Concepts



The notion of *architectural semantics* [16, 23] is central to Visserian Metaphysics. Architectural semantics is what captures the relation between a specification language and architectural concepts in order to provide meaning to specifications *Figure 2-3* (adapted from [4])

Figure 2-3 Relation between Concepts, Modelling Language and Model



Architectural concepts represent elements of a subject domain (or universe of discourse). In the case of the domain of system behaviour, the universe of discourse consists of activities carried out by a system (or several system parts). Examples of architectural concepts that represent elements in this universe of discourse are the notions of action and interaction, which represent activities and shared activities respectively. By relating specification concepts in a specification language to (combinations of) architectural concepts, it is possible to provide (real-world) meaning to otherwise formal languages void of subject domain significance. For instance, it is possible to use Petri-nets to represent behaviours [19] (although such practice is not defended here), e.g., by representing actions through transitions.

Architectural concepts are also called modelling concepts in RM-ODP, and the distinction between architectural concepts and specification concepts has had high impact in the definition of that reference architecture (as well as that of ISO-OSI).

The work discussed in [4, 13, 14, 18], proposes a set of elementary or basic architectural concepts for the prescription of system behaviour. This set must be parsimonious [18, 25]: any non-elementary concepts that can be defined in terms of the other elementary concepts should not be included in the set of basic design concepts. The set of basic concepts should be such that it should be possible to relate any meaningful valid specification to combinations of instances of the basic design concepts.

The distinction between basic design concepts and specification concepts can be illustrated with an example. Let us consider the specification of infinite behaviours. In the subject domain, infinite behaviours consist of activities which occur *ad infinitum*, e.g., activities which repeat themselves sequentially. One could represent these infinite behaviours by writing infinite specifications; provided that one could write infinite specifications(!). However, since all workable specifications are finite, the concept of recursive behaviours can be included in a specification language to represent an infinite combination of actions. The concept of recursion is not required in the set of basic concepts, since recursion can be understood as defining an infinite structure of actions related by causality. It is important to stress this distinction here: set of basic architecture concepts define the semantic domain for specifications and not a set of concepts for writing specifications.

The implication of this for behaviour as defined by Visserians is that the behaviour of a system (or system part) includes (exhaustively) all possible actions and interactions which a system may perform and their relations (irrespective of how behaviour is specified). We will return to this observation after a thorough analysis of philosophical foundations of Visserian Metaphysics.

3. Visserian Metaphysics and Nomological Essentialism

Classification is one of the most important features of human cognition. Many laboratory results provide evidence that infants in the early age of 3-4 months are already able to form types (categories). As [9, p.11] puts it: *"categorization . . . is a means of simplifying the environment, of reducing the load on memory, and of helping us to store and retrieve information efficiently"*. Without category concepts, we would be like Borges' character Funes [1] who was unable to forget anything, and of whom Borges wrote: *"to think is to forget a difference, to generalize, to abstract. In the overly replete world of Funes there were nothing but details, almost contiguous details… the present was almost intolerable in its richness and sharpness, as were his most distant and trivial memories"*. In other words, without a capacity to create types and to classify entities under them, mental life would be chaotic. If we perceived each entity as unique, we would be overwhelmed by the sheer diversity of what we experience and unable to remember more than a minute fraction of what we encounter. Furthermore, if each individual entity needed a distinct name, our language would be staggeringly complex and communication virtually impossible. In contrast, if you know nothing about a novel object but are told it is an instance of *type* X, you can infer that the object has all or many properties that things of *type* X have [20].

A type, thus, can be said to be an abstraction of one of more properties of individuals that can be used to classify these individuals. However, the individuals that we talk and think about can be classified in all kinds of ways. For example, we can sort things by colour (e.g. creating the class of red things) or by shape (e.g. the class of things with circular form) or by properties that define classes of things such as the classes of elephants, thunderstorms, oak trees, cars and students. Intuitively, however, before we create a type *Red* that includes a red apple and a red ball, we have already used the types *apple* and *ball* to individuate and classify the individuals at hand. It is for this reason that types such as apples, elephants, trees and thunderstorms are named *Natural Kinds* [7] or *Natural Types* [21] in the literature.

Historically, this intuition has been captured through the notion of "essence". This notion has pervaded philosophical discussions since Aristotle and refers to the common idea that many types exhibit a kind of duality between *essences* and *surface features*. By essence, what is generally meant is a number of properties which: (i) an individual has in every possible situation (i.e., that it could not have lacked); (ii) makes the individual *what it is* (to use an Aristotelian jargon). Thus, to simplify things, according to essentialism, you and me, we are people because we have a person essence that makes what we are and we are people in every possible circumstance that we exist. In other words, like it or not, a person is what you are and always is going to be.

In recent years, there has been a movement towards a neo-essentialism but with a quite different guise. For example, in a paper entitled *"Natural Kinds, Homeostasis and the Limits of Essentialism"* (cited by [6]), Boyd suggests an (re)interpretation of essence, as an attempt to explain the underlying aspects of entities that demarcate natural kinds. He argues that *"kinds…are natural if they reflect important features of the causal structure of the world."*, thus defending that: (a) essence is intrinsically causal in nature; (b) kinds are natural to the extent they are causally important in explaining phenomena associated with its instances. This type of essentialism is named *Nomological Essentialism*. It is important to highlight that this conception of essence finds support in many authors in cognitive sciences [6, 12] and it has been empirically supported by works such as [17]. In particular, [17] provide some empirical evidence that human cognition employs *causal domain theories* (and not typicality or frequency of properties) as its most important *principle of application* (way of classifying things), and this is the case for both objects and processes, natural entities and artefacts, and for entities of familiar and unfamiliar kinds.

In most scientific texts written by Visserians we can find statements such as *"[t]his chapter argues that the relevant properties of…people, machines and telematics systems constitute its behaviour"* [26, p.30]. Moreover, in a Visserian framework, a: (i) behaviour is defined as a "set of related actions"; (ii) the relations between actions are *causal relations*. Finally, the Visserian notion of behaviour is that of type (not of token), i.e., the behaviour specification of an entity is not a spatiotemporal located actual execution of behaviour but a description of all possible behaviour executions that a thing can exhibit. We can conclude then that Visserian Metaphysics takes the "most relevant properties" of things to be their causal-structured actions. Thus, for a Visserian: (a) two things belong to the same type if they share the same behaviour(b) the behaviour of a thing defines "what the thing is"; (c) since a behaviour of an entity cannot change inside the model, then a behaviour determined by a type is essential to things of that type. Thus, our first claim here is that (A1) *Visserian Metaphysics* is *nomological essentialist* metaphysics.

4. Essence, Individuation and Parthood

Two of the most discussed problems in metaphysics are the problems of individuation and the problem of identity. The latter is related to questions such as "What makes two things the same?", and "What changes can an entity undergo and still be considered the same?" The former is related to questions such as "How many distinct things do we have here on the table?" Let us propose two *thought experiments* related to these questions.

TE 1: Suppose I show you in instant t_1 a clay statue of the Dalai Lama. Suppose that at t_2 an accident causes the right hand of this statue to be destroyed. Now, if I ask you: *"is the thing I have in t_2 the same as the one I had in t_1?"* A *determinate* answer to this question can only be given if we (mentally) replace *thing* by a type such as statue, lump of clay, or maximally-self-connected physical object. So, while we still have the same statue in t_2, we do not have the same lump of clay.

TE 2: Suppose I show you a blue long-sleeves shirt. Now, if I ask you: *"how many things do I have here?"* Again, a *determinate* answer to this question can only be given if we (mentally) replace *thing* by a type such as shirt. Otherwise, since arbitrarily many parts of a thing are still things, one cannot know if he is suppose to count 1 object (entire shirt), 3 objects (the centre of the shirt plus the two sleeves separately), 500 objects (counting arbitrarily demarcated parts of shirt which are still things, plus all separated threads), and so on.

One of the most supported arguments in the philosophy of language is that individuation, persistence and identity statements are only possible with support of a type that defines "what a thing is" (e.g., [10, 5, 8]). However, there is also a strong relation between identity, persistence and individuation, on one hand, and parthood on the other. Thus, when one utters "that statue", one is referring to the whole statue and not to one of its arbitrary parts. But, one is also specifying what are the parts the object which is been referred to. It specifies for example that the Christmas decoration which is ornamenting the statue is not part of the object which is being referred. Additionally, "what the thing is" specifies what properties and, in particular, what parts, a thing can change and still be considered the same. For instance, changing an engine in a car does not alter its identity, but changing a chassis does. The parts that a thing cannot change without ceasing to exist as the same are named *essential parts* and to persist as the same individual is to persist maintaining all its essential properties, and in particular, all its essential parts.

Following this discussion we have that what counts as the parts of an individual is determined by the natural type of that individual, i.e., by "what the thing is". Our second claim here is that idea is also supported in Visserian Metaphysics and the argument goes as follows. In a Visserian framework, an entity is taken to be merely a *"carrier of behaviour"* [26], and, the only function of every part constituting the structure of an entity is to support the execution of a certain piece of behaviour. Now, we have that: (i) the pieces of behaviour (actions and interactions) that can possibly be exhibited by an entity determine the parts constituting the structure of this entity; (ii) the pieces of behaviour that an entity can possibly exhibit is determined by the behavioural specification of that entity; (iii) a type is a behaviour specification. From this we can conclude that, (A2) in Visserian Metaphysics, the parts of a thing (its structure) is determined by the type of that thing.

5. Types of Types and Visserian Creatures

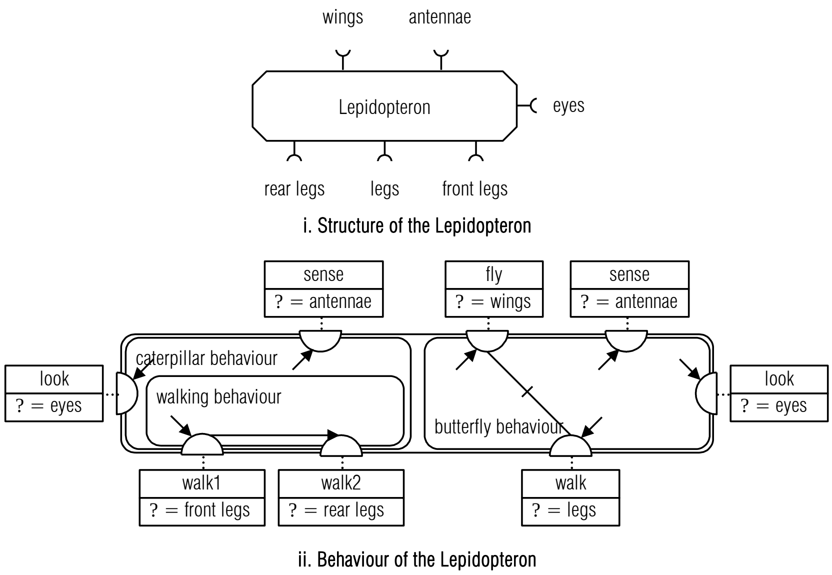
Up to this point, we have been focusing on the so-called natural types that things instantiate, i.e., the types that determine their essence. However, besides its natural type a thing can instantiate many other types. For example, besides being a person, which is something John is necessarily, John is also a researcher, a husband, a Dutch citizen, an F.C. Twente supporter, etc. So, besides the types that things instantiate essentially, there are types that they instantiate contingently. Whilst an individual X cannot cease to instantiate an essential type Y without ceasing to exist, for every contingent type Z that X instantiates, there is a counterfactual situation in which X does not instantiate Z. For instance, although John is a researcher in current circumstances, there are counterfactual situations in which he was not one (e.g., when he was a teenager) and there may be other situations in which he will no longer be one (e.g., when he is retired).

As we have previously discussed, a Visserian type is a behaviour. However, in a Visserian framework an entity cannot be ascribed different behaviours (types) at different circumstances. Thus, a behaviour specification is a description of all possible behaviour executions that a thing can exhibit. In other words, a Visserian type describes the essential behaviour exhibited by a thing. But it also describes the set of all contingent behaviour executions which can possibly be exhibited by that thing. Take for example the case of John above. There is no way to represent that John exhibit always a *person behaviour* but in certain circumstance it also exhibits a *researcher (husband, Dutch,…) behaviour*. Thus, to describe the behaviour of individuals such as John, we have to define a *person-researcher-husband-…-behaviour* to be ascribed to entities of that type. Now, due to (A2), we have that the structure of things of a given type is determined by the behaviour specification of that type. However, if a behaviour specification includes all possible behaviour, then the structure of Visserian types must also include all possible parts that things of that type can have. This is because, since the structure is immutable in this framework, it must also include parts to support possible actions. Thus, if on one hand a caterpillar-butterfly (lepidopteron) behaviour specification must include all possible behaviour that individuals of that type can exhibit, a lepidopteron structure must include all possible parts of those individuals (e.g., it must include both wings and legs).

Figure 5-4 shows the specification of the lepidopteron, developed using the basic concepts. *Figure 5-4*.i shows its structure and *Figure 5-4*.ii shows its behaviour. The structural specification shows that the lepidopteron has wings, antennae, eyes and legs that it uses to interact with its environment. It needs these interaction points as a butterfly. The structural specification also shows that the lepidopteron has rear legs and front legs that it needs as a caterpillar (along with its eyes and antennae).

We structured the behaviour of the lepidopteron into two parts: a part that represents its behaviour as a caterpillar and a part that represents its behaviour as a butterfly. Repetition of behaviour is not represented to keep the model simple. As a caterpillar, the lepidopteron moves its front legs and rear legs successively in a caterpillar fashion. Independent of this walking behaviour it can look and sense, using its eyes and antennae, respectively. As a butterfly, the lepidopteron can walk or fly, but not at the same time (as represented by the line that connects these two interactions). Independent of this walking behaviour it can look and sense, using its eyes and antennae, respectively. Once the lepidopteron exhibits butterfly behaviour, it no longer can exhibit caterpillar behaviour (this constraint have been omitted in the figure).

Figure 5-4 Specification of the Lepidopteron



The hybrid creatures composed of possible parts are named here *Visserian Creatures*. An illustration of a visserian creature[2] is provided in *Figure 5-5*.

Figure 5-5 Example of a Visserian Creature: a Lepidopteron

[2] Although we have used a natural (i.e., non-artificial) system to illustrate the implications of the relations between structural and behavioural characteristics in Visserian Metaphysics, the same conclusions apply to artificial systems, such as, e.g., user interfaces. If we consider a windowing system with buttons and dialogues as interactions points between the user and the application, a Visserian Window would show all possible buttons and dialogues at the same time (even disabled dialogues that may never be required in a particular execution of the application).

6. Epilogue: An Art-Theoretical Explanation for Visserian Creatures

Visserian Creatures have remained undiscovered in Visserian Metaphysics until the present article. A possible explanation for their presence, nonetheless, is that this is merely a curiosity, or an insignificant side-effect in Vissers' Ontology of Reality. This is not the view sponsored in this article. We believe that Visserian Creatures tell us something very deep about our cognitive rationale for aesthetics appreciation. Moreover, we believe that this is a feature that Vissers, *qua* the artistic, *qua* the sculptor, has hidden from Vissers the engineer in the depths of his metaphysics.

In an article entitled *"A Neurological Theory of Aesthetic Experience"* [15], the neuro-cognitive scientist V.S. Ramachandran provides a number of neurologically grounded and, hence, universal laws of artistic appreciation. One of these laws is what he names "Peak Shift" and he explains it (didactically) using the following example: *"Imagine you're training a rat to discriminate a square from a rectangle. So every time it sees a particular rectangle you give it a piece of cheese. When it sees a square you don't give it anything. Very soon it learns that the rectangle means food, it starts liking the rectangle. And it starts going towards the rectangle because it prefers the rectangle to the square…But now the amazing thing is if you take a longer skinnier rectangle and show it to the rat, it actually prefers the longer skinnier rectangle to the original rectangle that you taught it…[this is] because what the rat is learning is a rule - Rectangularity. And of course therefore if you make it longer and skinnier, it's even more rectangular. So it says: 'Wow! What a rectangle!' and it goes towards that rectangle."* Another similar example can be found in the experiments made by Niko Tinbergen at Oxford with seagull's chicks. As soon as the herring-gull chick hatches, it looks at its mother. The mother has a long yellow beak with a red spot on it. And the chick starts pecking at the red spot, begging for food. Then Tinbergen asked himself: "*How does the chick know as soon as it's hatched who's mother? Why doesn't it beg for food from a person who is passing by or a pig?*" And he found that you do not need a mother and not even a real beak. He took a long yellow stick with three red stripes, which does not look anything like a beak - and that is important. And he waved it in front of the chicks and the chicks go berserk. They actually peck at this long thing with the three red stripes more than they would for a real beak. They prefer it to a real beak - even though it does not resemble a beak. It is as though they had found an *ultrabeak*.

The common factor in both examples is that the rat and the seagull chicks were not searching for specific individual rectangles or beaks. Instead, they search for *types (universals)* such as rectangularity and beakness. Once they find an object that ultra-exemplifies those types, or an object that has an appearance closer to the stereotypical representation of that type, their limbic systems are hyper-stimulated as if they were saying "Wow, what a beak (rectangle)!"

What does this have to do with art? What Ramachandran suggests is that *"if those seagulls had an art gallery they would hang that long yellow stick with three red stripes on the wall, worship it, call it Picasso, but not understand why - why am I mesmerized by this damn thing even though it doesn't resemble anything?"*. The idea is that the human brain is also specially tuned to search for types (a position also held by many other researchers, for instance, [10]). Thus, if we encounter an artefact which embodies an ultra-representation of that type, we shall behave exactly like those seagulls, i.e., we shall have our limbic system hyper-stimulated and we will like that artefact without knowing why. Many exemplar manifestation of this rule can be found both in western and eastern works of art. An example provided by Ramachandran himself is the bronze statue of the goddess Parvati in India (*Figure 6-6*) dating back to the 12th century. Parvati is supposed to represent the embodiment of the universals of beauty, sensuality and femininity. What the Indian sculptor in this case did was to amplify those female attributes that characterize the type womanhood (e.g., when compared to men, bigger breasts, bigger hips and narrower waists). So, despite being distorted and anatomically incorrect, when one looks to Parvati's statue, one does not say "that's anatomically inappropriate" but "Wow, what a goddess!"

Figure 6-6 A Bronze Statue of the Goddess Parvati

Now, going back to Visserian Creatures. As explained in the previous section, these creatures are the concrete embodiment of all possible types that things with a given essence can instantiate. They are embodiments of a conflation of all possible universals, or an ultra-universal of a given type. Therefore, in summary, the theory sponsored in this article is that Visserian

Creatures are not just a side-effect hidden in the body of Visserian Metaphysics but an intentional message hidden by *Vissers, the sculptor* on how to hyper-stimulate our limbic systems. Finally, according to some authors (e.g., [22]), there is a strong correlation between aesthetics quality and design quality in artificial systems design. If this is the case, Visserian Creatures may hide an even more encompassing message of how we can build better artificial systems in general and telematics systems in particular.

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