Contemporary Engineering and the Metaphysics of Artefacts: Beyond the Artisan Model*

In the last two decades, the philosophy of artefacts has grown into a substantial field. Various philosophers have proposed and discussed ways of determining the nature and identity conditions of artefacts; others have scrutinised possible definitions of artefact functions. Simultaneously, cognitive psychologists have gathered empirical evidence about how people identify and distinguish artefacts. Furthermore, these two disciplinary groups appear to be interested in each other's proposals and results (Margolis and Laurence 2007).

A shared starting point in this literature is that artefacts and their functions deserve independent treatment. Most philosophers agree that artefact kinds are not natural kinds; most cognitive psychologists agree that people distinguish artefacts from natural objects. In consequent attempts to develop an appropriately autonomous account of artefacts, two intuitions have commanded virtually all attention. One is that artefacts are related, more intimately than natural objects, to intentional actions. Some authors stress that recognising intentions is important or even necessary in identifying artefacts; others offer conceptual or empirical reasons to reject this. The other intuition is that artefacts are identified and recognised by their functions. Some authors regard artefact functions as essential properties; others deny this. Studies into the relation between artefact functions and intentional actions combine these two intuitions.

In this paper, we reconsider these intuitions in the light of another feature of existing philosophical work on artefacts, namely its minimalistic view of the actions and agent roles involved in dealings with artefacts. The model implicit in most of the literature is that of an *artisan*, a single person who produces relatively simple artefacts, starting with a (perhaps personal) desire and ending with a finished product. This *artisan model*

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does not distinguish designing and making artefacts, but describes both activities with a single term. This lack of differentiation contrasts with contemporary engineering practice, in which many agents, playing different roles, contribute to artefact production. These differences may even hamper engineering and have led to attempts at integration, exemplified by techniques like ‘concurrent engineering’ and ‘Integrated Product Development’.

That philosophical work on artefacts rests on an outdated model of artefact production need not be a shortcoming. There may not be significant differences between the actions and roles involved in artisanship and contemporary engineering, or these differences may have no philosophical repercussions.

In this paper, we prove false both of these assumptions. First, we outline how contemporary engineering may be reconstructed. In sections 1 and 2, we present previous work on designing, using and artefact functions, and in section 3 we extend the analysis to producing, eventually distinguishing, four roles: plan-designing, product-designing, making and manufacturing. Second, we argue in section 4 that this update of the artisan model brings out a relation between designers’ intentions and what we shall call “instrumental kinds,” and between productive intentions and the class of artefacts. It does not, however, afford a clear relation between the intentions of any of the agents involved in producing the artefact and membership of an artefact kind. This undermines a prominent view in the metaphysics of artefacts, held by Risto Hilpinen and Amie Thomasson, in which “maker’s” intentions determine membership of artefact kinds. This view works on the artisan model, but it does not fit contemporary engineering. Therefore, an update of the artisan model in the philosophy of artefacts is both possible and necessary.

1. The Use-Plan Analysis of Use and Designing

We start our reconstruction of the actions and agent roles involved in contemporary engineering by analysing use and designing in terms of *use plans*.[1] A use plan of item *x* is a series of goal-directed, considered actions in which manipulations of *x* are included as contributions to realising the given goal. Suppose, for instance, that person *a* wants to tell person *b* about some last-minute changes to a co-authored paper. Realising such a goal commonly involves planning, i.e., systematic deliberation about a sequence of actions to be undertaken to realise the goal. In this case, *a* might walk to *b*'s office and tell him which changes were made; *a* might send *b* a copy of the latest draft by airmail; or *a* might send *b* an e-mail, attaching a document with marked changes. These scenarios involve different plans. The first, walking-and-telling, consists of a number of actions, none of which involves the manipulation of an item other than *a*'s body; thus, in our terminology, walking-and-telling is not a use plan. The second plan presumably includes manipulation of a printer, paper and an envelope. Hence, we call this series of considered actions, including printing a document and folding printed papers into an envelope, a use plan *up*; more specifically, it is a use plan for the printer, paper and envelope. The third plan involves manipulation of *a*'s computer and assumes manipulation of *b*'s computer; it is a use plan for, minimally, *a*'s computer.

Use can be characterised as carrying out a use plan, and reconstructed as involving the following steps:

U.1 The user *u* wants to bring about goal state g_u, and believes it does not obtain.

U.2 *u* chooses a use plan *up* for bringing about g_u that involves the intentional manipulation of items $(x_1, x_2, \ldots)$.

U.3 *u* believes that the physical circumstances support realising *up* and that he possesses the necessary skills.[2]

U.4 *u* intends to carry out *up* and acts accordingly.

U.5 *u* observes g_u' as the outcome of *up* and compares g_u' with g_u.

U.6 *u* believes that g_u has been brought about or not. If not, he may decide to carry out *up* again or to repeat the entire *U*-sequence. If he repeats *U*, he may reconsider the intended goal state g_u, select another use plan *up′*, or do both.

In deliberating about how to achieve a goal by manipulating an item (step *U.2*), an agent chooses a use plan for that item. This may, but need not, involve the construction of a use plan by deliberation. If *a* employs an existing option of his word processor to track changes in the document, he executes a use plan constructed by someone else.

This allows a conceptual distinction between use and designing. We characterise designing as constructing and communicating a use plan and, subsidiary to that, as describing the types of items manipulated in the plan. In this analysis, designers primarily aim at aiding prospective users to realise their goals.[3] Central to such assistance is developing a sequence of actions to be undertaken by users and communicating it to them, via, e.g., user manuals, explicit instruction, features of the artefact, against a background of known habits and cultural patterns. This does not entail that designers always deliberately develop a use plan for the items concerned. For many items, such as new types of cars, the use plan is tightly constrained or even fully determined by customary use. And in some cases, designers might make nondeliberate or bad choices about the use of an item; but even then designing means choosing, although perhaps not consciously constructing, a use plan.

Like use, designing can be reconstructed as involving a number of steps:

D.1 The designer *d* wants to contribute to a user's goal of bringing about a state g_u.

D.2 *d* believes that the state g_u' is the closest consistent and viable approximation of g_u, and intends to contribute to bringing about g_u'.

D.3 *d* believes that if the users follow an appropriate use plan *up* that involves the manipulation of items (x_1, x_2, . . .), this will contribute to bringing about g_u', and intends to construct this plan *up*.

D.4 *d* intends to contribute to producing items x_i, x_j, etc. that do not yet exist by *product-designing* them.

D.5 *d* intends to communicate *up* to the users.

D.6 *d* believes that g_u' can or cannot be brought about by the users to whom *up* is communicated. This belief is based on observing that some users go through a sequence of actions *up′* and bring about g_u'' , and on comparing g_u'' with g_u'.

D.7 *d* decides that her goal to contribute to bringing about g_u' has been achieved or not. In the latter case, *d* may repeat the entire *D* sequence, settle on another plan (return to *D.3*), re-product-design at least one of the items x_i, x_j, etc., (return to *D.4*) or re-attempt communication (return to *D.5*).

For instance, a designer *d* wants to help users *u* with writing coauthored papers. *d* can realise her aim by coming up with a series of actions including, say, the manipulation of two papers containing ‘radio-linked electronic ink’: changes in the wording in one paper immediately result in changes in the wording in the other paper, including a request to validate them. Such a futuristic use plan consists of actions with documents and ink; and designing the plan would involve describing currently nonexistent items, such as the ink. The latter activity is called ‘product-designing’. Although often regarded as the paradigm of engineering design, it is subsidiary to ‘plan-designing’ on our analysis. In section 3, we analyse this subsidiary step. First, we consider two important features of artefacts that can be modeled by means of our use-plan analysis.

2. Technical Functions and Instrumental Kinds

The previous analysis of use and designing can be applied to characterise a technical function ϕ of an item *x* (from here on: ‘the function ϕ’) as the physicochemical capacity for which *x* is manipulated in a use plan *up*. Phrased in terms of elements of three general analyses of functions—the Intentionalist,[4] Causal-role,[5] and Evolutionist theories[6]—this characterisation gives rise to what we have called the ICE-theory, the central definition of which reads:

> An agent *a* justifiably ascribes the physicochemical capacity to ϕ as a function to an item *x*, relative to a use plan *up* for *x* and relative to an account *A*, if and only if:
>
> I. *a* believes that *x* has the capacity to ϕ;
> *a* believes that *up* leads to its goals due to, in part, *x*’s capacity to ϕ;
>
> C. *a* can justify these beliefs on the basis of *A*; and
>
> E. *a* communicated *up* and testified these beliefs to other agents, or *a* received *up* and testimony that the designer *d* has these beliefs.

This definition is normative, since it states conditions for *justifiable* function ascriptions, but it fits many examples of actual function ascriptions. Those it does not fit may, on the basis of the definition, be evaluated as groundless.

The I-condition expresses that, in ascribing functions to an item, an agent *a* should believe that the item has the capacity to ϕ when it is manipulated according to the plan, and that by exercising this capacity the item contributes to realising the goals of the plan. Moreover, as expressed by condition C, the agent should be able to justify these beliefs. For engineers, the justificatory account *A* consists of scientific and technological knowledge, or systematically gathered experience of successful performance. Users and nonprofessional designers may instead rely on testimony by other users or designers. To introduce this latter source of evidence, we require, in condition E, that designers communicate to prospective users that they (that is, the designers) have developed use plans and have the beliefs stated in condition I. This communication should provide the prospective users with testimonial evidence for the beliefs that the artefacts have been produced or selected for the capacities corresponding to their functions. Moreover, condition E captures the intuition that functions are, to some extent, ascribed from a privileged (designer) perspective: a function is a capacity that is selected by someone, presumably for a good reason, and that is communicated to others, presumably to aid them in using the item in question. This does not exclusively privilege engineers or other technological professionals: in our analysis, every agent who develops and communicates a use plan and who can justify it, if only by systematic experience that it works, is a designer. Furthermore, in spite of all evidence, the item may fail to have the supposed capacity; it may then be described as malfunctioning.

Switching to a metaphysical perspective, one can use the ICE-theory and its use-plan background to differentiate items into 'instrumental kinds': an item *x* is a member of instrumental kind *K* in case it is justifiably ascribed the technical function to *K*, i.e., if and only if it is involved in a use plan *up*, and is justifiably believed to have a capacity to *K* that contributes to the realisation of the goal state of *up*. Examples of instrumental kind terms are 'cooling agent', 'hadron collider', and 'painkiller', and also less evidently functional terms such as 'coffee table' and 'water-flush toilet'. The use-plan background and ICE-conditions provide criteria for determining whether an item is a member of an instrumental kind; several of these criteria appeal to the intentions of designers and/or users and the beliefs underlying these intentions.

Instrumental kinds are not, to borrow Thomasson's (2007, 61) phrase, 'essentially artifactual kinds'. There may be instrumental kinds of which only artefacts are members, e.g., the kind of interplanetary probes, but most instrumental kinds have natural objects among their members. Conversely, some artefacts, such as synthetic molecules, may not be members of any instrumental kind. Furthermore, membership of instrumental kinds is highly context-dependent, where knowledge of use plans provides much of the relevant context. On successful redesign, an item is enrolled into a new instrumental kind, in some cases without any physical modification: tablets of Aspirin have long been members of the instrumental kind 'painkiller', but have recently also become members of the kind 'blood-thinner'. This is a direct consequence of relating function ascriptions to plan-designing rather than product-designing. The resulting dynamics of kind membership can be curtailed somewhat by limiting membership of instrumental kinds *K* to items of which the *proper* function is to *K*. This keeps books from being members of the kind 'table-stabiliser', but it does not make instrumental kinds essentially artefactual (some river water arguably has the proper function to cool power plants), nor does it prevent items from being members of two or more instrumental kinds (tablets of Aspirin arguably have two proper functions, as they are designed, marketed, prescribed and used in the context of two use plans).

The dynamics of technical functions also pleads against taking functions as essential properties (e.g., Baker 2004).[7] And, more generally, the intention-dependence of instrumental kinds may be sufficient for some authors to regard them as too 'conventional' and consequently as not 'real' (e.g., Elder 2007). We do not to take a stand on this, if only because there are no criteria to determine how much conventionality is inappropriate for real kinds. We do note, however, that instrumental kinds support some projectability: if an item is a member of an instrumental kind *K*, one may reasonably expect that it can be used to *K* or, in other words, that it has the capacity to *K*. This may not be enough, but a metaphysics of artefacts based on technical functions and use plans cannot do more.[8]

3. Artefacts and Productive Actions

To characterise the class of artefacts, we go on to develop the intuition that artefacts are items intentionally produced by humans. In our analysis, this naturally leads to taking a further look at product-designing.

In section 1, we characterised product-designing as describing an item that does not yet exist and that is intended to play a contributing role in a use plan *up*. Such items, e.g., a new variety of cell phones or hybrid cars, must be product-designed to make them available to prospective users of *up*. Product-designing can be reconstructed as follows:

PD.1 The designer d believes that an item x with physicochemical capacity ϕ does not exist.

PD.2 d intends to contribute to realising the goal state g_{dx}, consisting of the existence of a description of an item x with physicochemical capacity ϕ.

PD.3 d intends to describe an item x with physicochemical capacity ϕ for realising g_{dx}.

PD.4 d believes that a composite of the components $(c_1, c_2, \ldots)$, where c_1 has capacity ϕ_1, c_2 has capacity ϕ_2, etc., has the desired capacity ϕ.[9]

PD.5 For each component c_i, d intends to contribute to bringing about the goal state g_{dci}, consisting of the existence of a description of an item c_i with capacity ϕ; if d believes that this item c_i already exists, then design task g_{dci} is fulfilled by describing this item. If d believes that this item c_i does not exist, then another decomposition step *PD.4*, component design task step *PD.5* and integration step *PD.6* is made in order to fulfil design task g_{dci}.

PD.6 d believes that the various design tasks g_{dci} are fulfilled simultaneously, i.e., that the item x composed of the described components $(c_1, c_2, \ldots)$, has the capacity ϕ.

PD.7 d intends to communicate the description of item x, possibly along with instructions for production and assembly of it and/or its components to appropriate agents.

Describing new items is obviously not sufficient for making them available to users: the items need to be produced and/or assembled.[10] In principle, designers could engage in production themselves, or they could board out this activity to users. In contemporary life, however, designing and production are specialised activities of different groups of professionals. Hence, we distinguish a third agent role, that of making.

Like use and designing, making can be characterised as executing a plan, i.e., a goal-directed series of actions, aimed at bringing into existence an item *x*. Making *x* can be reconstructed as carrying out a make plan *mp* for *x*, and the relation to product-designing can be brought out by including a reference to the goals of another agent:

M.1 The maker *m* wants to bring about the existence of an item *x* as described by an agent *a* who, with that item *x*, wants to bring about the goal state g_a, and *m* believes that *x* does not yet exist.

M.2 *m* either chooses from a set of available alternatives a make plan *mp* for bringing about the existence of *x* that involves the intentional manipulation of items ($y_1, y_2, \ldots$), or he constructs a novel use plan *mp* by deliberation.

M.3 *m* believes that the physical circumstances support realising *mp* and that he possesses the necessary skills.

M.4 *m* intends to carry out *mp* and acts accordingly.

M.5 *m* observes x' as the outcome of *mp* and compares x' with *x*.

M.6 *m* believes that *x* has been brought about or not. In the latter case, he may decide to repeat the realisation of *mp* or to repeat the entire *M*-sequence.

In this reconstruction, making an item *x* involves two agents and two goals: the maker *m* who wants to bring about the existence of *x* and the agent *a* who, with that item *x*, wants to bring about the goal state g_a. These agents and goals may but need not be identical, which gives us freedom to describe a variety of cases. Agent *a* may be a product-designer, with the goal to make available to users an item *x* with a function ϕ, and *m* may take an active part in creating the product by deciding that the resulting item x' may not be identical to x, but is still a sufficient approximation, or even an improvement. Alternatively, m may be an unmotivated mechanic who just aims at producing x by following the detailed specification provided by a. The artisan model is included as a special case, in which a is identical to m. But whereas it is unclear whether artisans are designers as well as makers, our analysis explicitly leaves open the possibility that a is not a designer, meaning that x', the product of making, is not a member of an instrumental kind. An example of such 'pure making' would be assembling an item x with the aim (g_a) to show supreme skill in manipulating certain materials, e.g., assembling a model of a boat with toothpicks; or with the aim to show extreme patience and awareness of the transience of all material things, e.g., in creating sand mandalas. Also in this case, a and m could in principle be different agents, as when a parent (a) instructs his six-year-old child (m) how to construct an item (x) that consists of all available Lego bricks (g_a).

In any of these cases, the items ($y_1, y_2, \ldots$) referred to in step *M.2* include the materials from which x is formed, ranging from raw materials, such as sheets of metal and oil, to turnkey components, such as microchips and engines. The items ($y_1, y_2, \ldots$) also include the tools used to process these materials, including hammers, welding machines and cranes. Make plans contain actions such as aggregating sets of components and cutting, filtering and synthesising materials. Making necessarily involves modification of the physical properties of items by the *M*-sequence: the item x is never an element of ($y_1, y_2, \ldots$). In particular, the mere selection of an item is not regarded as making, not even as a limiting case. In this, we diverge from Hilpinen's characterisation of making as intentional modification of an item (1992, §I; 1993, §IV) where he allows intentional selection as a limiting case (1992, §VI; 1993, §VI), as does Thomasson (2007, 66).

The maker himself may determine the make plans *mp* for the items he intends to create. This situation is typical for the artisan model, in which the maker m is generally identical to the designer a.[11] In modern times, a transition has taken place. Increasingly, makers have stopped determining make plans. A first step in this transition has been a transfer of production management from makers on the shop floor to designers in the drawing rooms.[12] Nowadays, a second step has been taken, in which the development of make plans defines a separate engineering discipline, viz., that of *manufacturing*. In a US National Research Council report, manufacturing is defined broadly as "the processes and entities required to create, develop, support, and deliver products" (1998, 9). The few explicit characterisations of manufacturing we found contrast it with designing. Chang (1990, 39), for instance, takes designing as a process that ends with "a concept [for a physical entity that functionally satisfies a design requirement] expressed in a communicable medium;" manufacturing is then the field that translates this concept into instructions how to make the entity. With more precision, Simons and Dement write that "[u]nlike detailed design . . ., the process of manufacturing engineering is focused on developing designs and specifications for the manufacturing systems and processes required to actually build the artifact" (1996, 268).

To include this contemporary division of labour between professionals, we put one more step beyond the artisan model and incorporate manufacturing as a separate activity. Manufacturing facilitates making, as designing facilitates using: manufacturers design the make plans *mp* that makers carry out:

Mf.1 Manufacturer *mf* wants to contribute to a maker's goal of bringing about an item *x* as described by the agent *a.*

Mf.2 *mf* believes that an item *x′* is the closest consistent and viable approximation of *x*, and intends to contribute to bringing about *x′*.

Mf.3 *mf* believes that if the users follow an appropriate use plan *mp* that involves the manipulation of items (y_1, y_2, . . .), this will contribute to bringing about *x′*, and intends to construct this plan *mp*.

Mf.4 *mf* intends to contribute to producing items y_i, y_j, etc., that do not yet exist by *product-designing* them.[13]

Mf.5 *mf* intends to communicate *mp* to the users.

Mf.6 *mf* believes that *x′* can or cannot be brought about by the makers to whom *mp* is communicated. This belief is based on observing that some makers go through a sequence of actions *mp′* and bring about *x″*, and on comparing *x″* with *x′*.

Mf.7 *mf* decides that her goal to contribute to bringing about *x′* has been achieved or not. In the latter case, *mf* may decide to repeat the entire *Mf* sequence, settle on another plan (return to *Mf.3*), re-product-design at least one of the items y_i, y_j, etc., (return to Mf.4) or re-attempt communication (return to Mf.5).

This concludes our analysis of the actions and agent roles involved in engineering. We have made two steps beyond the artisan model in the direction of contemporary engineering, by first distinguishing making from designing, and then introducing manufacturing. In the next section, we discuss some consequences for a metaphysics of artefacts.

4. Discussion: Beyond the Artisan Model

Incorporating a distinction between designing, manufacturing and making brings a philosophical analysis of artefacts closer to current engineering practice. It presents possibilities that are not available on the artisan model, and reveals problems with identifying artefact kinds for an intention-oriented metaphysics of artefacts. We tackle these points in turn.

Our analysis decouples the class of artefacts from that of useful items, which is carved up into instrumental kinds. As argued in section 2, technical functions are ascribed against a background of plan-designing; the products of this activity, use plans *up*, determine instrumental kinds such as 'painkiller'. Membership of these kinds depends on, among other things, the construction and social entrenchment of use plans. It can therefore change over time. Instrumental kinds are not essentially artefactual, since natural objects can be members of instrumental kinds. Moreover, artefacts can be members of more than one instrumental kind. Aspirin and devil's claw (an ominously named wild plant) are both painkillers; and Aspirin is also a blood thinner.

Adding making and manufacturing to the analysis, we can identify artefacts as items *x* that are created by a successful execution of a make plan *mp*. Thus, we distinguish the class of natural objects from that of artefacts. Merely selecting an item is insufficient to create an artefact: making involves physical modification of materials, possibly with the aid of tools. Furthermore, not all artefacts are members of instrumental kinds: making neither creates nor presupposes a background for ascribing technical functions. Other agents besides product designers may incite makers, and thus non-useful items such as transuranic elements and 'made from all my Lego-bricks'-contraptions can be recognised as artefacts.

The distinctions on the level of items and on the level of agents and activities make our account of human dealings with artefacts flexible also in accounting for the existence of malfunctioning items and for changes in the ways items are used. Yet this flexibility comes with a seemingly steep price. For once the artisan model is left behind, identifying artefact kinds on the basis of maker's intentions is no longer straightforward. This identification is the cornerstone of some metaphysical accounts of artefacts, most notably those of Hilpinen (1992; 1993) and Thomasson (2003; 2007). Thomasson, for instance, characterises artefacts in various places as "intended products of largely successful intentions to create something of that kind" (e.g., 2007, 59), and refers to the agents who have these kind-determining intentions as "makers" or "artisans."[14] In the artisan model, this term is sufficiently determinate, since there is only a single productive role. In our analysis, which is more faithful to contemporary engineering, there are three, or even four, productive roles and thus a variety of candidate kind-determining intentions, as well as some constraints. Whose intentions win out: the plan-designer's, the product-designer's, the manufacturer's, or the maker's?

To start with the latter: literally applying Thomasson's artisan-oriented formulation to contemporary-engineering cases runs into problems regarding indifferent makers. Assembly-line workers qualify as makers on our analysis, but might just want to make a living or outdo colleagues; their intentions may thus not be related to the kind of artefact they are making. Ascribing to these makers "substantive and substantively correct ideas" about those properties of an item that are relevant to its artefact kind (Thomasson 2007, 59) is overly generous.[15] Plan-designers cannot be so indifferent: on our account, they deliberately construct use plans. However, these plans only determine instrumental kinds, which are not essentially artefactual: plan-designers might just as well select a fallen log as a place to sit as develop an innovative chair.

This leaves product designers and manufacturers. By our characterisations, these agents act deliberately, and their intentions are related to the characteristics of the produced item: product-designers intend to describe items with physicochemical capacities that contribute to realise the goal state of a use plan (e.g., tablets of pharmaceuticals that, when swallowed, help users to alleviate their pain); and manufacturers intend to contribute to maker's goals of bringing about items, as described by still other agents. However, product designers and manufacturers may have incomplete or conflicting notions of what is required to create a successful object of the kind. Current attempts at implementing Integrated Product

Development (e.g., Ding and Eliashberg 2002; Harris and Raviv 2002) bring to light these shortcomings: if either product-designers or manufacturers by themselves had substantive and substantively correct intentions to create something of an artefact kind, there would be little need to involve other agents who contribute to the early stages of product development; cross-functional teams and designing-for-manufacturing would then at most improve communication of the exclusive kind-determining intentions of one group. In practice, however, early involvement of agents in various professional roles is needed to make sure that the product is designed in such a way that it fits, e.g., manufacturing capabilities and existing supply chains (Naveh 2005)—vital elements in contemporary artefact production. Thus, in contemporary engineering, none of the agent roles involved has the requisite substantive, kind-determining intentions.

One could respond that there is no clear discontinuity between artefacts that are produced by artisans and artefacts that are produced by contemporary engineering processes. This makes it unlikely that, say, 15th-century artefacts are metaphysically different from 21st-century artefacts. Hence, if there are kind-determining intentions for the former, there must be similar, albeit harder-to-find intentions for the latter. This continuity argument is plausible, but it could backfire: the problems with finding kind-determining intentions nowadays may be taken as evidence that such intentions were also absent in the past.[16]

Another way to save kind-determining intentions is to point out that we have only shown that there are many conflicting, incomplete, and secondary intentions in integrated product *development*. Once a product-designer has described an item with particular capacities, an artefact kind is determined, although further details for its development and production remain to be filled in. Product-designers then have kind-determining intentions after all, and manufacturing and supply-chain issues only concern further development. One difficulty with this argument is that it underestimates the changes wrought in initial proposals because of 'secondary' concerns about manufacturing. Another, more important problem is that it threatens to insubstantiate kind-determining intentions. "Largely successful intentions to create something of an artefact kind," based on "substantive and substantively correct ideas" do not seem to tolerate large corrections to initial product-designs. And if kind-determining ideas can be so corrected and still count as substantive, the resulting metaphysics of artefacts seems to leave room for the products of seriously misled designers.

A third route for saving kind-determining intentions is to argue that product-designers, manufacturers, and makers *collectively* determine artefact kinds. Cross-functional teams may be said to develop collective intentions about their products, based on all relevant characteristics of the product and the production process. Developing this argument would require serious effort. A variety of proposals for reconstructing collective intentions is available in the literature, but none of them comes close to orthodoxy, or to modeling cases as complex as contemporary artefact production. Moreover, the literature on engineering teamwork shows that conflicting conceptions and intentions among participants often survive intensive teamwork (e.g., Bucciarelli 1996).

Hence, our conclusion is that intentions that determine artefact kinds are much harder to find once we move beyond the artisan model, towards contemporary engineering. A metaphysics of artefacts that emphasises these intentions, such as Hilpinen's or Thomasson's, therefore strongly relies on the artisan model for its success.

To compensate for this critical conclusion, we finish with a constructive suggestion. Rather than looking for kind-determining intentions, one might employ the reconstructions offered in section 3 to emphasise the kind-determining role of make plans. Just as use plans determine function ascriptions, which characterise instrumental kinds, make plans may determine artefact kinds. This move ignores the historical origins of the plans, which may be the result of individual or collective efforts. It is therefore more strongly reconstructive than the quasi-descriptive accounts presented by Hilpinen and Thomasson. It remains to be seen whether such a reconstruction, rooted in contemporary engineering practice, provides a sufficiently solid basis for an intentionalist metaphysics of artefacts. In this paper, we have more modestly provided a metaphysics of artefacts that distinguishes the class of artefacts, and non-essentially-artefactual, instrumental kinds.

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Notes

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1. Houkes et al. (2002), Houkes and Vermaas (2004), Vermaas and Houkes (2006).
2. Not all steps are strictly sequential; in particular, the beliefs mentioned in *U.3* are used to assess the relative utilities of the available alternatives or to construct a novel use plan in *U.2*. Moreover, the beliefs mentioned are oversimplified. In many cases, plans will be chosen or constructed on the basis of comparative or less apodictic beliefs.
3. This characterisation of designing resembles Herbert Simon's: "Everyone designs who devises courses of action aimed at changing existing situations into preferred ones" (1981, p. 129).
4. Abstracted from, e.g., Neander's (1991) theory of technical functions.
5. Cummins (1975).
6. Abstracted from, e.g., Millikan's (1984) theory of proper functions.
7. We argued against function essentialism in Houkes and Vermaas (2004).
8. Some authors, e.g., Elder (2004; 2007), offer an etiological, non-intentionalist account of functions and distinguish artefact kinds by these functions. While this avoids the conventionalism of our instrumental kinds, existing accounts of this type run afoul of our desiderata for theories of artefact functions (Vermaas and Houkes 2003), in particular that of ascribing the correct functions to innovative types of artefacts.
9. In case there is only one component, x is identical to c_1 and ϕ to ϕ_1.
10. We ignore nonproductive activities needed to make artefacts available to users, such as distribution.
11. Even in the artisan model there are exceptions, as when *m* is an apprentice craftsperson and *a* a master.
12. Brown (2000) describes this process in nineteenth-century engineering in the US and UK.
13. If, say, the right machines for making *x* singled out by the manufacturer *mf* do not yet exist, she may decide to have them made first.
14. There is some evidence that recognising productive intentions is important in identifying artefacts (Bloom 1996; 1998), but the matter remains disputed in cognitive studies. Malt and Sloman (2007) survey the empirical results.
15. Kornblith (2007) makes a similar point, without connecting it to the artisan model.
16. Ingold (2000) offers an argument against the importance of maker's intentions for "primitive" artefacts such as wicker baskets.

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