Exploration of the Application of 'Ready-to-hand' and 'Present-at-hand' in the Design of Systems

Timothy L.J. Ferris
Systems Engineering and Evaluation Centre, University of South Australia
timothy.ferris@unisa.edu.au

Abstract

This paper explores the concepts of ready-to-hand and present-at-hand, appearing in Heidegger's *Being and Time* in the design of systems. However, Heidegger's work presents a number of difficulties and these particular concepts, while apparently enlightening, cannot be accepted along with the rest of Heidegger's thought. Consequently the paper discusses the legitimacy and consequences of taking some insightful concepts from Heidegger and translating them to another context.

Introduction

Without prejudice concerning the validity of the full range of Martin Heidegger's ideas concerning the nature of being and the nature of people, this paper explores the application of certain aspects of his thought to the engineering task of conceiving and designing systems. The particular concepts explored in this paper are 'present-at-hand', *vorhanden*, and 'ready-to-hand', *zuhanden*. The author holds strong reservations about many aspects of Heidegger's thought including, but not limited to, the traces of Taoist and Buddhist thought (Watts, 2001, 73-78), the fact that Heidegger's primary emphasis was in investigating the nature of being (Perotti, 1974, 61) and the personal and political ambiguities presented by his life and work (Collins, 2000, Watts, 2001). However, notwithstanding these reservations, it seems useful to explore the possibilities opened by the distinction between *vorhanden* and *zuhanden*. This presents a methodological problem concerning the legitimacy of abstracting particular concepts from a philosophy and building an application upon those ideas. The difficulty concerns whether such an action implies acceptance of the whole of the system from which the ideas are abstracted, or whether the ideas extracted carry with them other aspects of the system from which they are taken. Should it be that the system adheres to its parts, then the parts cannot be free, and the result is an entanglement of the recipient locale and the system from which the idea was taken. Should parts be extracted from a coherent system there is a denial of the system as a whole, which of course may be intentional on the part of the extractor as has been suggested above is the author's intent, and consequently the decontextualization of the parts may denude them of their strength.

Background

In discussing systems design this paper addresses the matter of the design of structures of tangible stuff, ideas in the form of procedural instructions, software, the users and direct interactees with the system and the organisations or societies into which the systems are placed. In parsing this definition of systems we shall consider each major subsection. "Structures of tangible stuff" refers to the collection of hardware that is part of the final system. Hardware is tangible in the sense of being stuff that can be handled and is amenable to sensory perception. "Ideas in the form of procedural instructions, software" are statements of actions to be taken by some part of the system in order for the system to perform its role. Thus, it may be software in the sense of computer software, procedural instructions that a computer converts to action in processing data or in controlling some kind of actuator,

However, software may take a form such as instruction manuals, providing people with procedures by which to effect particular tasks. “Users and direct interactees” refers to the people who are directly involved with the use of the system. Such people are concerned with issues such as the effect of anthropomorphic characteristics on the useability of the system. This contrasts with the final section concerning the “organisations or societies” in which the emphasis is on the higher level interaction of systems and their context. There are cases in which systems have failed because the system has not properly addressed the contextual issues of the social milieu in which it is expected to provide service.

Systems are designed and so embody the result of intention. The intention used in the development of a system results from a combination of reflecting upon the situation that the system must address and the resources and constraints presented to the designer.

The practice of Systems Engineering was commenced as a response to the growing complexity of designed systems following World War II and the attendant risks related to performance, schedule and budget in development projects. During the past half century system complexity has grown considerably, with development of larger systems with more ambitious objectives, and increasing interconnectedness of systems and the development of systems with substantial digital software. The goal of Systems Engineering has been to develop means for doing projects that can reliably yield satisfactory outcomes. An important area of Systems Engineering is in the front-end stage of defining what system should be designed. This front-end process demands understanding of the context into which the system will be deployed so that it embodies characteristics that enable it to be effective for its purpose in the context of its intended deployment. This concept is elaborated in classical Systems Engineering texts, such as Blanchard and Fabrycky (1998, 1-45). But Systems Engineering concern with matching the product to its true purpose and its users and its context of deployment is also recognised in some other fields. Thus, Vicente (1999, 11-58) develops a similar theme in the context of ensuring that systems are designed to conform to their context in the most appropriate manner from the point of view of the operators. Vicente was not altogether successful in this attempt (Ferris, 2003a). However, the newness and radical nature of the concept is seen in the difficulty that some have with developing it into a coherent integrated process. An example of such an appending of the concept at the end of a work in project management, rather than as the core organising concept of a work in systems design and development is Khisty and Mohammadi (2001, 1-13,422-446).

A second strand of background is more personal. In reviewing Dittrich *et al* (2002) I (Ferris, in press) noted (Floyd, 2002, 10) as a core concept, contributing to the creative approaches of the authors in the book, was the reference to present-at-hand, *vorhanden*, contrasted with ready-to-hand, *zuhanden*, derived from Heidegger. This distinction was one of Heideggers major concepts in the analysis of being in *Being and Time, BT* (1973, I, 3). In addition I have discussed this point, in contrast to the mechanistic and process emphasis response to the US DoD acquisition processes that has come to characterise much of Systems Engineering in the USA, with several Continental European scholars at INCOSE 2003[1]. The mechanistic and process approach is the line taken by Bergman *et al* (2002) in which the argument was put that the risk of project failure can be reduced greatly by increasing attention to the development of the proposed system requirements. This argument is vigorously supported by those who believe in the traditional, process driven, approach to Systems Engineering. My

[1] *International Council on Systems Engineering Symposium*, Washington DC, 29 June-3 July, 2003.

discussions with Continental European Systems Engineers were centred on the Heideggerian concepts of *vorhanden* and *zuhanden* as exposing a flaw in the traditional Systems Engineering approach. I found that the particulr people to whom I spoke understood the salient features of Heidegger's distinction of *vorhanden* and *zuhanden*, More importantly, they seemed to regard the distinction as important for understanding of the system specification and design phase of system development. My sample and method of research are quantitatively meaningless, but indicate qualitatively that this issue should be investigated and may well prove to very significant.

This is important in my approach to the matter, being chronologically the third of a series of observations of a cultural difference among Systems Engineers between USA and Continental Europe. The first glimmer of this cultural difference was expressed in the conclusions of Ferris (2003b). The second was in the book Dittrich *et al* (2002) and the third was the personal discussions.

Prior to this I had investigated the problem of the failure of the classical Systems Engineering approach of formal requirements definition as a reliable method to develop products as a problem in classical epistemology of the realist and critical realist traditions (Ferris, 2002). That work came to a halt, suffering from the essence of one reviewer's criticism " a lot of work but it is unclear what use it is." Dittrich *et al* (2002) seemed to open a new pathway of investigation.

Intellectual Systems

Jackson argued that the notion of *complementarism at the level of methodology*, or pluralism, cannot be obtained by mixing methodologies in any pragmatist manner. That is, methodologies used for the development of systems only yield their particular benefits if the methodologies are used in a manner that is consistent with their theoretical foundations (Jackson, 2003, 88). This position of Jackson's implies that fragments of intellectual systems cannot, or should not, be abstracted from an intellectual system in which they are embedded without respect for their original context.

Another situation in which ideas have been abstracted from their original intellectual structures and brought to other places is in the idea of dialog of religions. Dialog of religions refers to the practice, of some participants and scholars of religion, of seeking insight into religious experience by sharing ideas and practices derived from other, distinct, religions. The move for dialog of religions came after World War II, which saw the Holocaust and soon after the Partition of India, and the violence of each case, by those supporting dialog of religions, being attributed religious intolerance (Dawe, 1978, 13-14). The response was to emphasize that which different religions have in common, rather than that which differs. As a means of addressing conflict between participants of different religions the methodology is seriously flawed because it does not engage the fact that people tend to respond more to the differences that divide than the similarities that unite in a matter as sensitive as religious faith. The underlying reason for this sensitivity to difference is the sense people have of their religion forming a coherent whole that stands distinct from other religions, particularly in its claim to provide a complete pathway to the truth.

If each religion is a coherent whole, then its parts are not separate entities that can be explored and analysed as distinct entities, a parallel to *vorhanden* will be observed when the latter is discussed, but rather as just a facet of the whole that is inseparable from the rest. Therefore any outcome of seeking interpretive insight in one religious system effected by

extracting and abstracting aspects of another does violence to the source religious system by the removal of the segment from its context. In removing the segment from its context this process degrades the significance of the context in the source system of the insight and this denudes the insight of much of its power to enlighten because it reduces it to a naked concept, rather than a rich concept, full of allusion and connotation arising out of its source context. In addition the act of extracting enlightening insights as objects from a system expresses a disrespect for the system from which the concepts are derived. The effect is that the borrower of the concept denies the very source context that gives power to the insightful idea.

The problem of damage to a system of thought is also found in the recipient religion. The recipient is a complete system that claims to provide a complete and coherent vision of the universe. By extracting some insight from another religion and placing it within what claims to be a coherent and complete system the coherence and completeness is challenged and disrupted. The challenge is effected because the person performing the deposit implies the view that the recipient religion is not complete or coherent until the extra insight is added. The disruption occurs because a new element is added. The new element brings with it connotations and allusions that belonged to it in its original context, the source religion. This connotations and allusions are matters buried within the worldview of the source religion that are foreign to the recipient. The effect is that new matters are introduced to the recipient, but at the same time there may be maters native to the recipient that conflict with the new matters introduced, with the result that there is a disruption of the coherence and completeness of the recipient religious system.

The matter of dialog of religions has been introduced because religions claim to provide coherent explanations of the whole of experience, where each religion is different, and the standard for judging coherence may be significantly different in each. Heidegger's work is a philosophical framework, and thus claims to provide a coherent explanation of the maters it addresses. The fundamental difference between a philosophical and a religious system is the claimed source of the system, not the systemic structural nature of the system. Thus discussion of religious systems is analogous to philosophical systems.

The above discussion shows that there are major risks associated with mining an intellectual framework system, as a more general analogy of a religious system, for ideas that provide insight into something else, needs presented, or felt, as a result of participation in or commitment to another system of a parallel kind.

This discussion indicates the risk of investigation of certain insightful concepts in one system for the purpose of applying those concepts in a situation quite different thatn the system in which those concepts were created. The investigation of *vorhanden* and *zuhanden* for the purpose of enlightening the design of systems presents a special problem. Heidegger disliked technology, and sought to live a simple life leaving aside matters of technology, even at relatively simple levels such as handwriting all his works, rather than using a typewriter (Watts, 2001, 2). In addition, Heidegger marginalised discussion of design, the process of making things with intention, which has been core to the rationalist tradition for 2500 years (Hill, 1997, 134).

The problem with design, and thus with technology as the designed, for Heidegger was both a personal attempt to live in the simple and traditional ways of rural Germany, with minimal technological help, and in the philosophy which sought to overturn the thinking of the rationalist tradition in relation to the question of being, and a peripheral issue, such as design was left aside. This presents a problem of the legitimacy of extracting two concepts related to

modes of being of things from a context in which design was given little emphasis and using them as key concepts in a theory centred on the process of design of systems.

Thus, in general, to extract concepts from an intellectual framework and to use them in another intellectual framework presents the problem of doing violence to the source framework context by extracting the concepts from there and depositing them in another context in which it is felt that the insights may be useful. The problem with this process is the extent to which the concepts migrate their connotations from their source context to their destination.

The second part is specific to Heidegger, that the particular use of *zuhanden* and *vorhanden* in a context of the development of technological design is contrary to the emphasis of his life and work. Therefore the outcome may be an application of the concepts in manner contrary to what Heidegger would have developed had he ever addressed the question of system design.

Placing these two caveats makes the exploration of *zuhanden* and *vorhanden* appear very much as a mining of Heidegger's corpus for a quite different purpose than that for which was created. At face value this would seem to be illegitimate. However, we shall proceed, seeking to explore the relation of systems design and the two concepts because it seems that the two concepts provide an insight in the approach to seeing and knowing things that may prove valuable in understanding the design of systems. The basis for proceeding is partly the empirical evidence of the Continental Systems Engineers having a perception of things and systems coloured by the concepts, whether or not they hold to the remainder of Heidegger's views.

Should the concepts be found enlightening in our understanding of things and systems it will remain to determine the appropriate conceptual system into which to place our enhanced view of systems and design. This major task will not be attempted in this paper.

Vorhanden

The concept of *vorhanden* is translated 'present-at-hand in *BT*. This is one mode of being in which being lies in the fact that something is, and is as it is in reality, which provides the mode of *vorhanden* for that entity (*BT*, 26). Awareness of the *vorhanden* character of an entity has a temporal structure because awareness is an event, which is necessarily tied to time and cannot be eternal. Thus, the awareness of *vorhanden* is a making-present of the entity (*BT*, 48), and thus brings the entity to a state in which it can become the object of some kind of relation to that which is aware of it, *Dasein*. The process of appearing that results in entities of the mode *vorhanden* being known is not a showing of themselves, but rather that they are evidenced by something else (*BT*, 52). These attributes of that which is *vorhanden* demonstrate that the word 'what', rather than 'who', is properly associated with the concept of *vorhanden* (*BT*, 71). Another characteristic of the *vorhanden* mode of being is that it is 'in-the-world' where 'in' means "sharing the same space as" (*BT*, 79).

The consequence of 'being-in' is that all entities that 'be-in' have a mode of being that can be reduced to *vorhanden*, but any such reduction of a view of the entity to merely *vorhanden* results in a denial of the higher modes of being that properly belong to the entity through the abstraction necessary to regard the entity as *vorhanden*. This possibility of abstraction of entities to *vorhanden* is a significant point in this exploration, and will be revisited later in the paper.

In contrast to things that are ‘in-the-world’ hut have a higher mode of being than is expressed in *vorhanden*, entities that only exist with the *vorhanden* mode of being are ‘belonging-to-the-world’ and so are a part of the world (*BT*, 93). The effect of being a part of the world is that such entities become a part of the context o0f which *Dasein* is aware and with which *Dasein* interacts. The entities that have the *vorhanden* mode of being correspond to the Ancient Greek usage of π_____, the stuff that is present and with which one must have dealings.

Zuhanden

Heidegger identified *zuhanden*, ready-to-hand, as a mode of being that contrasts with *vorhanden*. He argues that entities become accessible when we concern ourselves with them in some way, that is, when we care about them (*BT*, 96). To care for entities is to become interested in them in some way so that the entity is no longer a mere object at a distance from us, as something observed and analysed, as described in the *vorhanden* mode of being, but rather to come into some interested relation to the entity. The fact of care makes the entity of the kind described by the Ancient Greek π____, or ‘equipment’, *zeug*, that which is useful for something, and so to have a mode of being *zuhanden* (*BT*, 96).

Heidegger argues that strictly there is no such thing as ‘an equipment’ where ‘equipment’ means ‘something-in-order-to’. The ‘in-order-to’ character of the *zuhanden* mode implies a reference of something to something (*BT*, 97). That is, in the mode of being *zuhanden* the equipment is always linked to something else as an entity that has the purpose of effecting something other than itself for something other than itself. That which is *zuhanden* is known in its relational nature as equipment for a purpose, but is not known as what it is in itself because when we use something our awareness is of its purpose rather than of it in and of itself, that is, its mode of being *vorhanden* (*BT*, 98). Thus, in order to be *zuhanden* the *vorhanden* character must withdraw to release *Dasein* to perceive the entity as for a purpose. This relation of *vorhanden* and *zuhanden* follows because when equipment is used the awareness of the user concerning the purpose of the entity rather than awareness of the entity in and of itself (*BT*, 99). Now, work involves using something for achieving something, whether the purpose is public or private, and thus is dependant on use of equipment (*BT*, 100).

However, that which is *zuhanden* must also be reducible to *vorhanden*, since there can be no equipment where that equipment does not tangible exist as something that can be apprehended and analysed if one is able to penetrate beyond the perception of that entity as equipment (*BT*, 101). Consequently, that which is to be useful, has a mode of being of *zuhanden* and must have a mode of being *vorhanden*, and the difficulty in perceiving the *vorhanden* character arises because it is obscured by the *zuhanden* character that is most immediately perceived by *Dasein*.

Should an entity normally perceived according to its *zuhanden* character be broken then it is perceived in its not useful *vorhanden* mode of being (*BT*, 103). In addition, should an item perceived by one as *zuhanden* be apprehended by another, who due to a lack of appropriate experience or knowledge, is unable to perceive it as that particular *zuhanden* the latter may perceive it as a different *zuhanden*, that is as for a different purpose, or possibly as purposeless, and thus only as *vorhanden*.

All uses of that which has a mode of being of *zuhanden* relate somehow to serving one or more purposes of *Dasein* (*BT*, 116). Thus the generation of the *zuhanden* mode of being is

dependant on *Dasein* generating it as an additional mode of being for an entity that is first of all *vorhanden*. However, having effected this transformation of *vorhanden* to *zuhanden Dasein* then primarily perceives the entity as *zuhanden*, and only with difficulty, if at all, as *vorhanden*.

Heidegger also suggests that there may be some entities known as *zuhanden* that may not be encounterable and thus not knowable as objective entities that could be analysed, and thus their *vorhanden* character cannot be separated from their *zuhanden* character (*BT*, 122). Heidegger does not posit examples of *zuhanden* that cannot be encountered as *vorhanden*. It may be worth contemplating whether such entities as knowledge or inter-personal relationships may be such unencounterables, and thus only perceivable as *zuhanden* because we are unable to remove the interpretative overlays of the underlying *vorhanden* entity in order to be able to encounter and perceive that *vorhanden* entity in an of itself. If this is so it would provide a foundation for our difficulty in understanding such entities.

Dasein

Dasein is a key concept in Heidegger, and one about which I have significant reservations. Heidegger uses *Dasein* to name and describe the mode of being experienced by humans in their own existence (*BT*, 32). However, Heidegger does not definitively limit *Dasein* to humans, and so it is possible, or plausible, that there is some other non-human entity that may also have the *Dasein* mode of being, but Heidegger does notdiscuss this perspective on the issue either. The distinguishing characteristic of *Dasein* is that *Dasein* is aware of *Dasein*'s existence, and is aware of the question of existence, and anything that is not *Dasein* is not so aware (*BT*, 32,33). Since *Dasein* is aware of its being and understands the question of being, one of the pursuits of *Dasein* has been to pursue and explore the nature of *Dasein*'s being seeking the authentic meaning of being (*BT*, 62). This pursuit contrasts with the other pursuit that *Dasein* conducts in parallel, which is shared in various ways by other entities, of seeking to support its material being. That is, in parallel with pursuit of questions of the nature of being *Dasein* also pursues the mundane matters of life that enable physical support of the body in a desirable manner. *Dasein* pursues these mundane matters in a more sophisticated manner than other entities, but the other entities do pursue the mundane in some way, as their primary activity.

Dasein is not of the mode of *vorhanden* because it is not something that we 'come across' as we go about (*BT*, 69), but rather it is close to us, and is well known because it is inseparable from ourselves, but it is little understood in everyday experience because it is very close to us (*BT*, 69). In addition, *Dasein* is not *zuhanden* because it exists but is not for the purpose of effecting something.

The traditional view of people has been as rational animals, ____ _____ ____, through rationalist concepts such as Decartes' "I think therefore I am", *cogito ergo sum*, but this yields Hiedegger with the problem that ____ is of a *vorhanden* kind and _____ is of an unclear kind of being, resulting in a person, viewed in this way having an indeterminate kind of existence (*BT*, 74).

At this point Heidegger departs from Ancient Greek and Christian anthropology, which both define man as essentially an entity (*BT*, 75). Heidegger introduces the idea of 'mineness' as a quality that belongs to *Dasein*, as being that which is the true nature of *Dasein*, which results in the possibility of *Dasein* living either authentically or inauthentically, depending on the way of life lived by *Dasein* (*BT*, 78).

Now *Dasein* experiences 'being-in-the-world' as sharing in the space of the world, but not as being a part of the world (*BT*, 79). Thus *Dasein* lives in the world as it is, and interacts with the world, but is of a different kind to the other entities in the world. A result is that it is possible to say *Dasein* is of *vorhanden* kind, but this either is a wilful disregarding of the 'being in' state of *Dasein* or an unintentional not seeing of that 'being-in' state (*BT*, 82). The possibility of seeing *Dasein* as either *vorhanden* or *zuhanden* results from the fact that in 'being-in-the-world' *Dasein* is constructed of stuff like the world and could be mistaken. Such a mistaking of *Dasein* for one of the other kinds of being would result in inappropriate relations and behaviour because it would reduce people to being either equipment or mere objects. That *Dasein* can be 'being-in-the-world', Heidegger's defining concept of *Dasein*, is the consequence of *Dasein* being able to know and to conduct I-thou relations, which are entities that cannot be known as of *vorhanden* kind. The view of *Dasein* as 'being-in-the-world' contrasts with the *vorhanden* which are, 'in-the-world' or 'belonging-to-the-world' and so parts of the world (*BT*, 93).

Previous western views of humanity regarded people as either bipartite, body and soul, or tripartite, body, soul and spirit, and lead to the assumption that a person is a synthesis of the parts, but in Heidegger's view *Dasein* is existence, not a synthesis of separately existing parts (*BT*, 153). Thus, Heidegger argues for regarding *Dasein* as a complete and indivisible being that enters into relations and intrinsically is a complete, unified, entity. There are multiple *Dasein*, which necessarily have some kind of relation to each other, whether warm and friendly or hermitic or otherwise, and these relations are characterized by Heidegger as 'Being-with' (*BT*, 160).

Dasein's being includes disclosedness in general, and *Dasein* possesses thrownness, being placed into a particular context in which all action is performed; projection, the potential to be and to become and to be disclosed; and falling, being lost in the world (*BT*, 264). These aspects of *Dasein* indicate that *Dasein* is a knowable being that belongs in a context that constrains possible action, but also has responsibility for effecting action that affects the world in which Dasein is placed but that *Dasein* shies away from taking this responsibility. This view of *Dasein* is related to the role of people in designing systems, in that in the system design role the person is in a context that affects what kind of system is desired and desirable.

Heidegger's *Dasein* involves some ideas about which I hold strong reservations. The idea that truth depends on *Dasein* perceiving because it is uncoveredness to *Dasein* excludes eternal truth unless someone proves *Dasein* is eternal (*BT*, 269). The problem with this view is that it makes truth subjective, depending on *Dasein*, rather than, as had been traditional, objective and perceived by the subject. The difficulty with this is a fundamental issue of whether truth is existent, to be apprehended by the subject or is truth because of apprehension by the subject.

Another difficulty for me is Heidegger's assertion that while *Dasein* is an entity it does not have wholeness, where the use of 'while' indicates a temporal, rather than logical 'while'. Heidegger claims that in order to gain 'wholeness' *Dasein* must lose its 'Being-in-the-world' and so cease to be an entity (*BT*, 280). Since Heidegger's concern is with the being of *Dasein* this concept seems to be a parallel with Buddhist thought (Perotti, 1974, 61). Heidegger follows that with a discussion of death in which he says each *Dasein* must do for itself, but that people regarded death as an unfortunate event for a person, rather than as the end to which all people progress (*BT*, 296). Later Heidegger says that death is an encounter of *Dasein* by 'the they', the other *Dasein* entities (*BT*, 297). This view of encounter by 'the they' in death shows the I-centeredness of Dasein in the exposition of *Dasein* in *BT*. The

emphasis on the I-centeredness of *Dasein* in *BT* results in a de-emphasis on the inter-personal relational aspects of human experience. *BT* does refer to the inter-personal aspect of 'the they', being the total of all other people, but this discussion is from the perspective that conforming oneself to the direction encouraged by 'the they' results in inauthenticity of *Dasein*, an essentially individualistic notion. The individualist strand is further expressed in Heidegger's view that *Dasein* exists for the sake of the potentiality-for-being of itself (*BT*, 416).

These matters concerning *Dasein* result in some of the concerns expressed at the start of the paper, and are a cause for consideration of the validity of taking the *zuhanden* and *vorhanden* concepts from Heidegger.

System Design

Engineering involves the development of stuff with the goal of satisfying a purpose of the party that called for the development project to be performed. In this description of engineering there is the seed of applicability of both the *vorhanden* and *zuhanden* concepts. Science has developed means of description and analysis of stuff so that the phenomena of the world can be described and understood. Therefore, the role of science is to break through the perceptual layers that result in people perceiving stuff as being something-for-something in relation to themselves, that is, to perceive the stuff in its *zuhanden* mode of being, and to release the observer to be able to analyse the stuff in and of itself in its *vorhanden* mode of being.

Science educators frequently encounter misconceptions of phenomena in students, where a common cause of the misconceptions is the difficulty of moving from seeing things as something in their context to seeing the abstraction of the particular phenomenon of interest, separated from its context. The misconceptions of science students are instances of the problem people have with seeing beyond the *zuhanden* character of something to its fundamental *vorhanden* nature.

In the engineering task of designing stuff to achieve an objective there are two aspects, the stuff that must be analysed to ensure that it performs in the intended manner, and the purpose, which is in a different realm of experience. The two realms are those delineated by Heidegger's distinction between *vorhanden* and *zuhanden*. In the analysis of the stuff that will be assembled into the system the designer's attention is focused on the *vorhanden* mode of being of the stuff, that is on the analysis of the stuff and its behaviour under specified conditions. Thus, the designer uses the perception of the material learned through the sciences in order to analyse the behaviour of the material under specified conditions with the goal of achieving specified performance under the specified conditions. In science laws and analytical methods are developed to provide a relation of kinds of stuff and conditions under which observations are made and the observation expected. In engineering the analytical processes are rearranged, in a mathematical sense of rearrangement of equations, to isolate the variable of the design target, and the conditions are adjusted until the desired performance is achieved. This kind of analysis is conducted at the *vorhanden* level, like the Heideggerian assertion that when a *zuhanden* character entity is broken it becomes perceivable in its *vorhanden* character because it can no longer present itself as of *zuhanden* character because of its brokenness. In design, the analysis is of material that has never yet been formed so as to have *zuhanden* character of the kind that is the purpose of the design effort. Consequently the designer's primary attention is on the analysis of the material, and so on the *vorhanden* character of the material.

The engineer, whose role is to continually work in the analysis of material at the *vorhanden* level, and who probably chose to pursue engineering as a result of personality traits including enjoyment of science and a dislike of the ambiguity and disorder often associated with dealing with situations involving people. A result is that most engineers feel most comfortable with dealing with things at the analytical level of the *vorhanden* mode of being.

Systems Engineering grew out of the realization that the conduct of large, complex projects was not always successful and deserved to be addressed as a specialist field of endeavour. Most introductory texts in Systems Engineering provide a significant discourse on the need for analysis of the need prompting the project so that the product can be assigned to effectively address all aspects of the need. In the Heideggerian analysis, the introductory texts point to the need to consider the *zuhanden* character of designed systems as entities designed to be something-for-something, that is to have a purpose for a user or other stakeholder. But then Systems Engineering seeks to transform the vision of the proposed system in its *zuhanden* mode of being into something amenable to thew methods of engineers, and thus to describe and analyse the system in a *vorhanden* mode of being. The means of this transformation presented by Systems Engineering is the Requirements Document and its development.

At its most abstract the Requirements Document defines the intended product system in a series of imperative statements of the form "*x* shall *y*", where *x* is the variable described in the statement and *y* is the predicate providing a complete and unambiguous definition of a characteristic of *x* that in combination with the predicates of the remainder of the requirement statement set will bound the range of product systems that would be recognised as acceptable by stakeholders such as the principal in a design and development contract. The Requirements Document defines a space of acceptable product systems in the space of hard, analysable stuff, that is, within the realm of stuff known in its *vorhanden* mode of being.

In classical Systems Engineering the Requirements Document is one of the fundamental steps in the performance of a project, and a good Requirement Document is regarded as a *sine qua non* of a successful project delivering satisfactory performance, on-tiome and on budget. The London Stock Exchange Taurus project, abandoned after expenditure of USD730 million is taken as a flagship example of the problem of poor requirement definition (Keil and Montealegre, 2000, Bergman *et al*, 2002). Bergman *et al* provide the standard Systems Engineering response to this problem, that the problem would have been precluded had the requirement elicitation and documentation phase produced a better requirement document. The difficulty presented is whether the current requirement elicitation processes are appropriate for transforming the vision of the product system from the contextualized setting of the stakeholders who envision the prospective product system from the viewpoint of its belonging within the context of their life as something-for-something, that is as having a prospective *zuhanden* mode of being. But the output of the requirement process is a document describing the prospective system in terms of attributes in the space of analysed things. Thus the requirements process in Systems Engineering makes a profound change of mode of being in its form of description of the prospective system.

I assert that the root cause of the frequent failure in the requirement aspect of projects follows from this difficult transformation from a *zuhanden* to a *vorhanden* representation of a prospective system.

I further assert that a change of project definition process is needed to determine effective, reliable and efficient means to perform the transformation required.

Intellectual System Context

The first major section of this paper concerned the problem of the legitimacy of extracting a concept from one intellectual system and placing that concept in a different context in which it would appear to be useful. The extraction of *vorhanden* and *zuhanden* from Heidegger's *BT* is problematic because of the centrality of Heidegger's idea of *Dasein* as an understanding of humanity. This is a problem because *zuhanden* differs from *vorhanden*, not in what the entity having the mode of being inherently is, but rather in the relation of that entity to *Dasein*. My concerns with Heidegger's *Dasein* have been indicated above in the discussion of *Dasein*.

The difficulty that an unwillingness to accept the whole of Heidegger's views presents is that the discussion of *vorhanden* and *zuhanden* in relation to the design of systems seems to indicate a number of points of enlightenment. How may this be resolved?

In Heidegger *vorhanden*, *zuhanden* and *Dasein* are distinctive modes of being. That is, Heidegger makes statements about the fundamental nature of entities in discussing these concepts, but being is not a concept, but rather the most basic reality from which *Dasein* questions (Goldman, 1977, 40). This framework is problematic and therefore demands that if these concepts of *vorhanden* and *zuhanden* are to be translated to another system that they be removed from connotations of modes of being as the distinction between them.

To remove the idea of modes of being would be to remove the heart of Heidegger's work, since the exploration of the nature of being was his primary life task. Therefore the action proposed performs extreme violence on the Heideggerian corpus.

Can *vorhanden* and *zuhanden* be extracted from Heidegger's question of being?

The salient issues in *vorhanden* and *zuhanden* as applied in the discussion of the design of systems was shown to be the relation of the person to the entities, not the mode of being of the entities. Therefore, the most promising pointer towards progress in this area is in the creation of an intellectual system in which there are modes of relation, rather than modes of being, that correspond to the relational aspects of *vorhanden* and *zuhanden* as discussed above. Clearly the relational aspect depends primarily on the person involved in the relation process rather than the inanimate entity. Consideration of this must be left to a further investigation.

Conclusion

Heidegger's thought presents a number of difficulties but his particular concepts of *vorhanden* and *zuhanden* appear to provide significant insight into a fundamental difficulty in the project goal definition phase of development of systems. The enlightening insights associated with understanding things in their context that underlie the concepts of *vorhanden* and *zuhanden* appear to be extractable from the whole of Heidegger's vision and to be applicable in a system of thought that explains the whole of the system design process. It would appear valuable to further explore this area, because as one approaches the matter of the relation of entities to people, and the consequent processes to design systems, it is likely that the view of people required to effectively perform this task will also yield benefits in understanding the inter-personal aspects of the process of developing systems through teams of engineers.

References

Bergman, M. King, J.L., Lyytinen, K., 2002, Large-scale requirements analysis as heterogeneous engineering, Dittrich, Y., Floyd, C., Klischewski, R., eds., *Social Thinking-Software Practice*, MIT Press, Cambridge, Massachusetts, 357-386.

Blanchard, B.S., Fabrycky, W.J., 1998, *Systems Engineering and Analysis*, 3rd ed., Prentice Hall, Upper Saddle River, New Jersey.

Collins, J., 2000, *Heidegger and the Nazis*, Icon Books, Duxford, and Totem Books, New York.

Dawe, D.G., 1978, Christian faith in a religiously plural world, Dawe, D.G., Carmen, J.B., eds., *Christian Faith in a Religiously Plural World*, Orbis Books, Maryknoll, New York, 13-33.

Dittrich, Y., Floyd, C., Klischewski, R., eds., 2002, *Social Thinking-Software Practice*, MIT Press, Cambridge, Massachusetts.

Ferris, T.L.J., 2002, Epistemological Issues in Representation of Things and Requirements Specification, *INCOSE 2002*, Las Vegas, 28 July-1 August, CD-ROM proceedings.

Ferris, T.L.J., 2003a, Book review, Kim J. Vicente, *Cognitive Work Analysis Toward Safe, Productive, and Healthy Computer-Based Work*, Lawrence Erlbaum Associates, Mahwah, New Jersey, *IEEE Transaction on Professional Communication*, 46, 1, 63-65.

Ferris, T.L.J., 2003b, Review of Papers Concerning Engineering Teams in INCOSE Symposia 1991 to 2002, *INCOSE 2003*, Washington DC, 29 June – 3 July, CD-ROM Proceedings.

Ferris, T.L.J., in press, Book review, Dittrich, Y., Floyd, C., Klischewski, R., eds., 2002, *Social Thinking-Software Practice*, MIT Press, Cambridge, Massachusetts, *IEEE Transaction on Professional Communication*.

Floyd, C., 2002, Developing and embedding autooperational form, Dittrich, Y., Floyd, C., Klischewski, R., eds., *Social Thinking-Software Practice*, MIT Press, Cambridge, Massachusetts, 5-28.

Heidegger, M., 1973, *Being and Time*, Macquarrie, J., Robinson, E., trs., Basil Blackwell, Oxford.

Hill, G., 1997, *The Architecture of Circularity Design, Heidegger and the Earth*, PhD thesis, University of Sydney.

Jackson, M.C., 2003, The origins and nature of Critical Systems Thinking, Midgley, G., ed., *Systems Thinking*, vol 4, *Critical Systems Thinking and Systemic Perspectives on Ethics, Power and Pluralism*, Sage Publications, London, 77-92.

Keil, M., Montealegre, R., 2000, Cutting your losses: Extricating your organization when a big project goes awry, *IEEE Engineering Management Review*, 28, 3, 67-80.

Khisty, C.J., Mohammadi, J., 2001, *Fundamentals of Systems Engineering with Economics, Probability, and Statistics*, Prentice Hall, Upper Saddle River, New Jersey.

Perotti, J.L., 1974, *Heidegger on the Divine The Thinker, The Poet and God*, Ohio University Press, n.p.

Vicente, K.J., 1999, *Cognitive Work Analysis Toward Safe, Productive, and Healthy Computer-Based Work*, Lawrence Erlbaum Associates, Mahwah, New Jersey.

Watts, M., 2001, *Heidegger A Beginner's Guide*, Hodder and Stoughton, n.p.