Exercise: What is wrong with this abstraction-decomposition space?

An abstraction-decomposition space has a structure that is defined by the principles of abstraction, decomposition and means-ends relations. The entries at each level represent objects, functions, values or purposes and must be appropriate to their designated level. Because this is a structural representation and not an activity representation, the entries should not be described as processes.

The connections between levels are means-ends relations, where the element represented at a lower level enables or supports the element to which it is connected at the next level up. Every entry must be part of an unbroken chain through the five levels from physical objects to domain purpose.

Common errors are to decompose over the abstraction dimension and to link domain functions to values that those domain functions do not support.

Figure 1 illustrates several violations of good form and validity for an abstraction-decomposition space. Before reviewing my outline of those violations, you might examine Figure 1 to see if you can identify the problems.
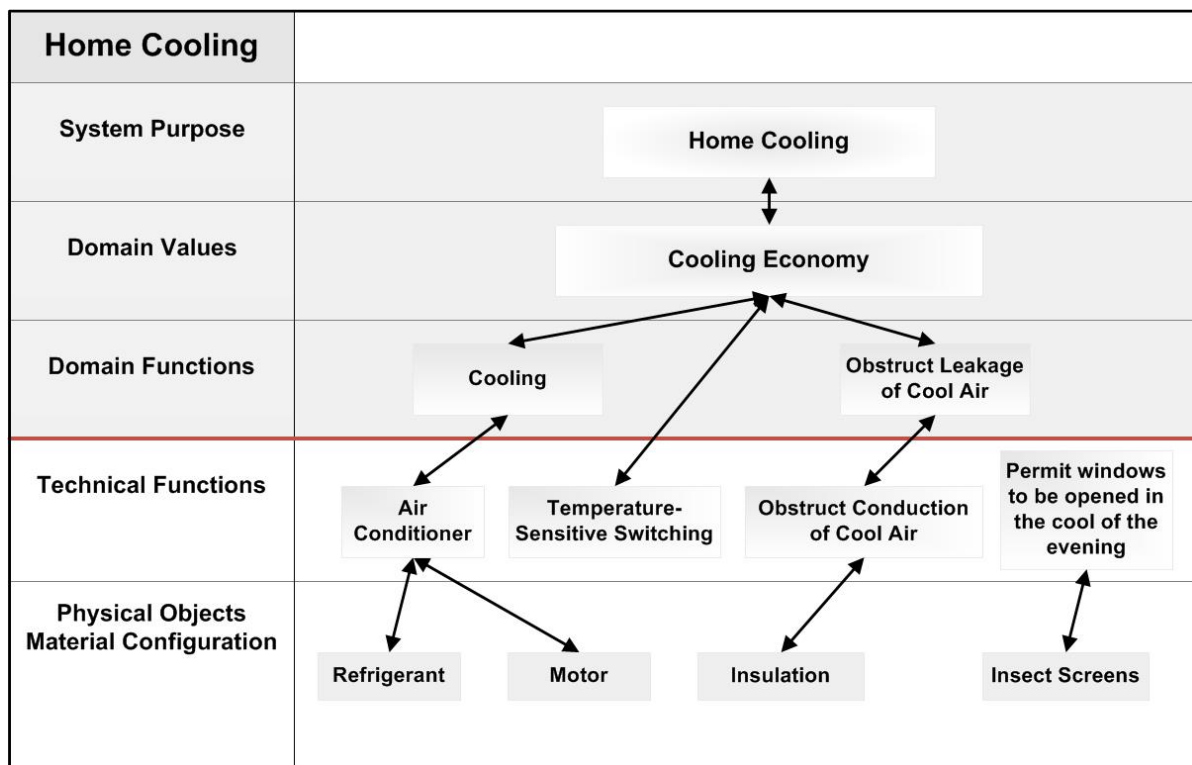

Figure 1: An abstraction-decomposition space for home cooling illustrating several violations of good form and validity

Violations of validity and good form; Figure 1

- The technical function of *temperature sensitive switching* is not supported at the physical objects level (you may leave gaps where it is understood that those gaps point to a part of your design problem to which you will soon attend).

- The technical function of *temperature sensitive switching* links directly to the domain value of *cooling economy* without any intermediary domain function.

- The means-ends pathway from *insulation* to *cooling economy* includes a semantic error. *Insulation* does not *obstruct conduction of cool air* (from inside to outside) but rather, limits the conduction of heat (from outside to inside). It is important, in maintaining the efficiency of cooling, to *obstruct leakage of cool air* (shown at the domain functions level) but that is not the essential function of *insulation*. Instead, that could be achieved by use of *gap sealant*, which should be identified at the physical objects level.

- *Leakage of cool air* is more appropriately shown at the technical functions level than at the domain functions level.

- The two functions, *obstruct leakage of cool air* and *obstruct conduction of cool air* are phrased as activity statements, which implies they are processes rather than functions.

- There is little to distinguish the domain purpose of *home cooling* from the domain function of *cooling*. These nodes should be described in terms appropriate for their particular level of abstraction.

- The domain function of *cooling* does not support the value of *cooling economy*. The other two legs in this abstraction-decomposition space do support *cooling economy* but there must be some other value within this domain that is supported by the cooling domain function. In the corrected abstraction-decomposition space (Figure 2), I add the value of personal comfort, which is supported by cooling.

- The *air conditioner*, shown at the technical function level, is a physical object and the *motor* and *coolant* are parts of that object. If they are to be included, they must be linked to the *air conditioner* node by decomposition relations, not means-ends relations.

- Although the *insect screens* will *permit the windows to be opened if the evening cools* as indicated in Figure 1, the entry at the technical function level does not describe the technical function of the screens. The appropriate description would indicate that they *obstruct entry of insects while allowing free flow of air*. An entry at the domain functions level would identify how those screens support *cooling economy*.

- The means-ends branch beginning with *insect screens* at the physical objects level does not continue up the hierarchy past the technical functions level. It is reasonable to include *insect screens* as physical objects within an abstraction-decomposition space concerned with home cooling where economy is a value, but this leg would need to be developed properly.

- Beyond the principles of good form and validity, there is a lack of balance in the abstraction-decomposition space of Figure 1. We might question why *insect screens* are included as physical objects when *ducting* and *fan*, surely more central to the home cooling domain, are not. Additionally, if we are to extend this abstraction-decomposition space to that extent, there are many other objects such as *sun-blocking blinds* and *double glazing on windows* that could also be included.

A corrected abstraction-decomposition space is shown in Figure 2, although note that this corrected abstraction-decomposition space is presented for tutorial purposes to illustrate the points made above and remains incomplete.
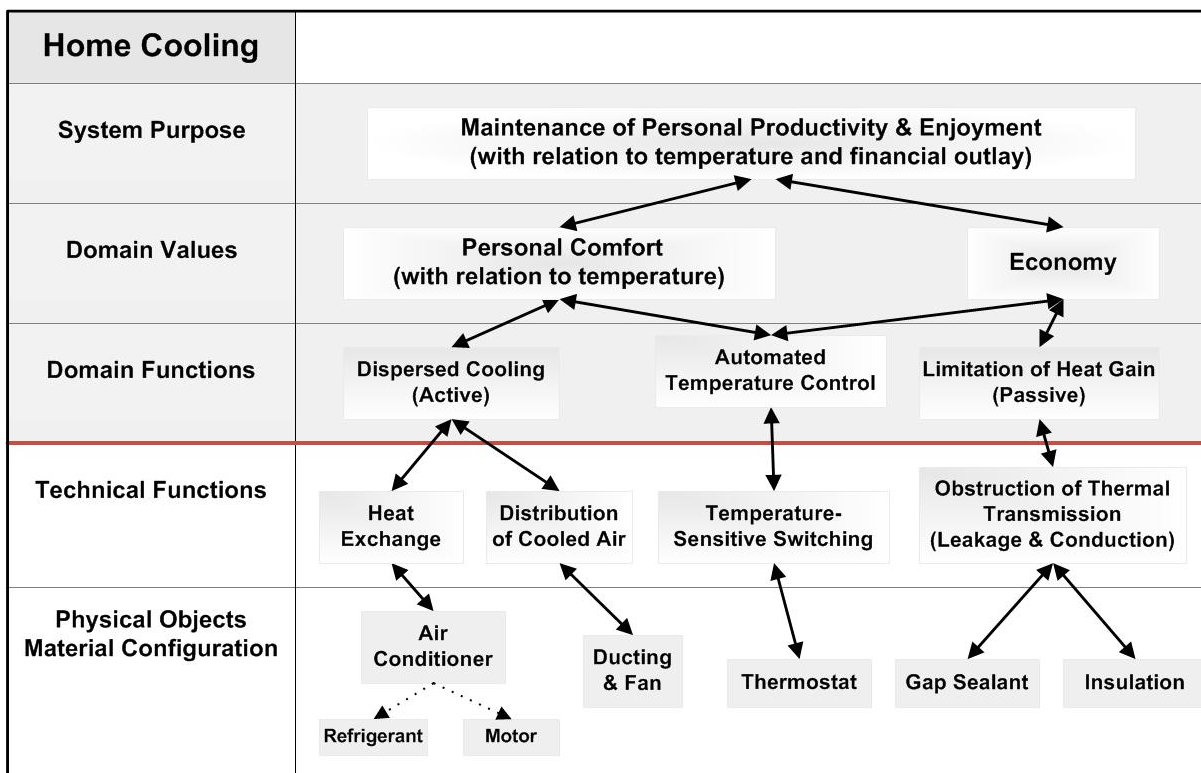

Figure 2: An abstraction-decomposition space for home cooling with corrections to the violations of good form and validity illustrated in Figure 1