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Sikorsky S-92 Case Study

It's always the simple things that "get you." This case was recounted by a high-ranking official of the company at a design conference.

Fig. 1: The Sikorsky S-92.



Sikorsky (<http://www.sikorsky.com>) is a world leader in helicopter engineering. One of their products, the S92 Helibus, was the result of a global collaborative engineering effort. While such international efforts are the way of the future, there also exists the danger of making the kinds of mistakes that would have never happened if only a single co-located company had been involved.

Case in point: the S-92 cockpit, fuselage, and tail sections are each made by different engineering companies, scattered across the world¹⁾.

There is wiring that runs from the cockpit all the way to the tail, through the fuselage. The designers of the cockpit and the tail spent a lot of time making sure that the wiring that started at one end would reach the other. But they forgot to involve the fuselage designers, who quite naturally omitted many of the passageways, ducts, trays, and conduits to let the wire get from the cockpit to the tail. This resulted in cost and schedule overruns as the fuselage section had to be re-designed once the error was detected.

The engineers involved were so concerned about the ends of the wiring (which are arguably the most important parts) that they forgot about the middle: the wires themselves. Wiring, after all, serves the very important function of transmitting signals from one point to another. The connectors at the ends of the wires might seem important to engineers concerned with the behaviour of the wire (its response to stimuli from the operating environment), but they forgot to consider its function (how it achieves the behaviour) – signal transmission.

Who is to blame? The cockpit and tail engineers could easily have sent an email message to the fuselage

team reminding them of their wiring needs. And the fuselage team could have realized that the other teams might need to connect things from the front of the helicopter to the back. Alternatively, it could be a failure of project managers who were supposed to make sure everyone was collaborating.

Or maybe it was an error arising from a corporate “system” and “culture” that didn't promote the idea of intense and even informal collaboration. Or even, it may have been a failure of all the engineers to bother to develop a proper, integrated model of what they wanted to do.

If there had been in place an AI system the knowledge-base of which contained mereologic (i.e. pertaining to parts and wholes) information about wiring, and if that system had had access to all the designs, it could have easily detected the error far sooner.

It is certainly possible to conceive of a knowledge-based system that could have detected the error without mereological information, but such systems would usually be based on some notion of constraint satisfaction rather than structural descriptions. The computational difficulties of dealing with generalized constraint satisfaction problems are well-known; such problems are typically NP-complete. Using mereologic principles, however, it is possible at least in principle to avoid those computational complexities. This would lead to more robust and efficient KBSs. Furthermore, because specifying part-whole relations is a more “natural” way of describing design information, the mereologic perspective should improve usability of KBSs.

Also, product function is intimately related to part-whole relations. Had a computer model of the wiring (including a model of the functions of wiring) been available to the engineers, then we can imagine that some AI-based consistency checker would have been able to determine that the fuselage did not provide the passages needed to let the wiring reach both ends of the helicopter.

case

1)

This is sometimes called the *24 hour office* because every 8 hours, one shift in one country ends just as another 8 hour shift starts at some other location 8 time zones away. Companies can therefore get 24 hours per day out of their employees without paying overtime.

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Last update: **2020.03.12 13:30**