Platforms and Modules, and Autonomy

Patrick Van Hoeserlande

Assumptions

We should reconsider accepted situations from time to time. However, when doing that, we must be aware of hidden assumptions. These are hard to detect and may unintentionally distort our thinking leading to limiting our solution space.

A few weeks ago, I read a NATO document about modularity for naval systems. At first, it read like a very sensible, logical document. Nothing surprisingly and a good approach to destruct this difficult issue. However, something kept nagging me.

The first indication of a hidden assumption was that the word ‘platform’ was undefined. Reading through the text made clear that a platform was implicitly assumed a manned (surface) vehicle. Modules, defined as “a grouping of units, including the support systems that perform a single independent function or task, and are separately testable. A particular mission module can be used in several mission packages” were technical systems, mostly unmanned. Trying to define the term ‘platform’, however imperfect, would at least have uncovered this assumption.

The second indication was that standoff was related to the existence of a Mine Threat Area (MTA) – yes, the document was about Naval Mine Counter-Measures -. MTA points to the issue with the word ‘minefield’. Even if such an area would be indicated on a map, there is no certainty about the whereabouts of the mines and even if there are really mines present. Mines are not limited to well-defined areas either. In short, mines can be and are possibly everywhere. It is more a question about uncertainty, about risk, than about a black-and-white situation.

What is the value of the term ‘standoff’ when there is no clear demarcation line? None. What is your risk appetite? What risk migration measures do you take to lower the risk to your acceptance level, your risk appetite?

Recognizing these assumptions and getting rid of them, what would be the result? Let us explore.

About platforms and modules

We can define a platform as a vehicle used for a particular purpose or to carry a specific kind of equipment or module.

In turn, we define a module as any in a series of units used together to perform a task.

Armed with these two definitions we can conclude the following:

- The function of a platform is to carry things.
- A platform can carry one or more (different) modules. Example: a ship carrying a command and a EOD diver module;
- Modules can be fixed or semi-fixed onto the platform, or easily removable;
- A module can in turn be a platform. We could also talk about modules and submodules in reference to a platform. Example: a ship can launch an Unmanned Surface Vehicle that brings an Unmanned Underwater Vehicle (UUV) to its mission area.
- A platform travels on land, in the air, in space, on or under the sea surface, in cyber space... It must use a medium to 'travel'. In most cases, the medium used by the platform and not the module determines to the component responsible for its employment.
- Platforms and modules may not exist as such; they may only exist when the (sub)modules are put together. Example: an UUV may be an assembly of guidance, propulsion, payload (with modules), and energy modules;
- Platforms and modules may be manned or unmanned.

This discussion fueled by the introduction of unmanned systems is not new. Unfortunately, the unmanned entry gives it a skewed consideration. Implicitly, people regard platforms as manned and modules as unmanned. I intentionally did not broaden the discussion by adding words like 'system, system of systems…as these would further muddy the topic.

If you think about it, the word unmanned is biased too. The word gives the impression that the system was originally "manned". Later 'man' was removed from it. This is not entirely true, although that was the case with earlier designs. "Not-manned" gives the wrong impression too. Maybe we should talk about inanimate systems instead. That word has the additional advantage that it is gender neutral.

Overt – covert

Another confusing use of words is the use of “overt” and “covert”. This black-white approach pushes the requirements for “covert” systems very high and conversations become minefields. Again, it is a matter of managing the gray zone of risks.

What are your intentions? What is your risk appetite that what you are doing will be discovered? How good is the other side at detecting abnormal activities? Although some systems are better suited for covert activities than others are, the discussion is really about intentions and less about systems. An ‘overt’ system can very well be used for ‘covert’ activities, and vice versa.

Autonomy

Another old discussion is that about autonomy. Viewed through the lens of employing inanimate systems, we quickly arrive at levels of autonomy and expressions like “man in the loop”, rules based decisions, artificial intelligence…

However, autonomy is not new. We train soldiers and teams to certain levels of autonomy. You can fill a shelf with books on (semi)autonomous teams. Even after extensive training, we are never certain what military will learn along the way and how they will act in a specific situation. However, we trust they will do the right thing. If not, they will be able to explain it logically to us. That is what we tell ourselves, but we know better.

Legally, inanimate systems make the question about responsibility a bit harder to answer, but from a Command & Control (C2) point of view, there are nothing new[1]. It is about employing platforms and modules in an effective and efficient way taken into account their capabilities and limitations.

The level of autonomy is not only determined by the C2 capabilities, although that may be the focus of the day. There are a whole set of factors with an impact on autonomy whereby the limit is set by the most restricting one. The table below gives an overview of those factors.

These factors are influencing each other. For example, using more AI to drive up the C2 independence requires more energy and thus reduces the time the system can operate without recharging. ‘Crewing’ a system could facilitate the C2 but requires live support modules demanding more energy. Designing a system is about finding the right balance between those factors for the task considering the technology available. The use of modules can make this balancing act a dynamic process.

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[11] A good read about the legal aspects on autonomous systems is HQ SACT’s ‘Current Vision and Legal Considerations of Autonomy V3’, 15 Sep 19.

There is an extreme form of autonomy whereby a system is launched to be never recovered. Deep space systems are built with this philosophy.

Autonomy Table

Factor	Question	Measure	Scale	Limitations	Ideas	Remark
Time-space	How far from the platform can the module operate?	Distance	0 over OTH to independent	• Cable • Communication reach		
Energy	How long can the module operate on the available energy?	Time	0 to long endurance	Internal energy storage capability	• Tethered • Energy stations • Flexible energy usage	
Logistics	How long can the module operate without external logistics?	Time	0 to long endurance		• Self-diagnostics • Self-repair • Graceful degradation • Redundancy	Launch and Recovery Systems
C2	How long can the module operate without external C2 input (without retasking)?	Level of 'autonomy'	Direct controlled to autonomous	Thrust (over and under)	Intra-modules collaboration	• Lessons Identified? • Learning
Navigation	How long can the module navigate within acceptable deviation limits?	Distance	No navigational abilities to independent	Non-GPS environment	Different methods	
Force Protection	To what threat level can the module operate in?	Threat level	Permissive to warzone	• Legal issues • Need to protect • Risk appetite	• Active and passive protective measures • Expandable	