Systems approach to LAWS
- characteristics, considerations and implications

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Motivation

- **The discussion on LAWS has been strongly platform-oriented.** It is natural and tempting to get stuck with the platform-level, as it is intuitive to see the functioning through the physical embodied machines. However, by doing so, some important aspects may be omitted.

- **The systems approach enables to analyze and understand various outcomes how LAWS can be manifested in the operational environment of a battlefield.**

- Furthermore, the systems approach help in characterizing the essence of the cognitive features and intelligence required in the functioning of LAWS.

Systems approach as methodology

- ***Complexity sciences* have especially been developed to understand and explain the nature of complex systems.** Typical characteristics to complex systems include, e.g., *stochastic behavior, non-linear dynamics, and emergent features*

- ***Systems engineering*** is an interdisciplinary approach providing methodology and practical means to enable successful engineering design and realization of complex systems.

- ***System of systems (SOS) approach*** seeks practical methodology to such issues as safety and risk assessment, reliability testing, and fault tolerance. The SOS approach also underlines the analysis of interdependent factors, like socio-technological relations.

Operational domain
- battlefield and infrastructure

- Simultaneous progress from two directions: the development of **on-board capabilities**; as well as in the **infrastructure** in the operation environment

- The C4ISR environment provides the intelligent infrastructure, as well as the **tight boundaries of operation for LAWS.**

- **The components of LAWS may be physically distributed** within the C4ISR-network. As an implication, **the boundaries of LAWS are ambiguous in many ways**.

- Related to the request of transparency and review process: By following the systems approach, one can observe and analyze LAWS and its decision making chains from various angles, including operational view, technological view, or organizational view.

The essence of cognitive features

- **The essential cognitive qualities are very context sensitive and deal with semantic information,** e.g., reasoning, memory association, problem solving, and learning in real-time.

- **LAWS will always begin to operate with incomplete information.** Semantic information processing and **communication between various instances and capacities within the system** are needed to sort out, judge, and decide, how to act in the given situation.

- As a consequence, the intelligence required in autonomous functioning is not an inherent feature of LAWS as a platform-specific characteristics. Instead, the **intelligence retains largely as a transferable quality of systems level that various platforms can adopt and utilize.**

Conclusion

- Whether LAWS should be somehow banned or restricted, the outcome of **restrictions would be very easy to neglect, if those were constructed either on technology-bases or by defining the allowed specifications of platforms.**

- Considering the dual-use nature and the speed of the development in the enabling technologies of LAWS, as well as the remark that complex autonomous features appear not only on platform-level, but also on systems level, it suggests that **the only rational framework to progress the debate would be in agreeing on the generic allowed principles in the development, deployment, and operation of LAWS.**