

Machines to compare notes online?

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The best way for autonomous machines, networks and robots to improve in future will be for them to publish their own upgrade suggestions on the Internet. This transparent dialogue will help humans to both guide and trust them, according to research published in *Proceedings of the Institution of Mechanical Engineers, Part I: Journal of Systems and Control Engineering*, published by SAGE.

In his paper, Knowledge of [machines](#): review and forward look, Sandor Veres of the University of Southampton's Faculty of Engineering and the Environment takes an engineering viewpoint of today's need for machines and systems with a greater degree of self-control. The leap to increased autonomy will be facilitated by machines and humans publishing systems information in a common language online, he suggests.

Autonomy is the capability of a system to pursue and fulfil its operational objectives without human intervention.

Today's automated systems already operate finely-tuned feedback loops in cars, aircraft, ships, manufacturing machines, chemical, agricultural and food production processes. Their functionality is supervised by human decision makers. Supervisory control and data acquisition (SCADA) systems increase productivity in manufacturing, and control utility networks such as power, water/waste, gas and communications.

But some systems need to operate for extended periods of time without the possibility of high level human supervision. Various [unmanned craft](#)

such as underwater survey vehicles, underwater robots, spacecraft, and semi-autonomous aerial vehicles and are all examples where loss of communication is either possible or inevitable: they require autonomous control for extended periods.

The next step beyond systems that need autonomy due to being cut off from human controllers is the concept of network autonomous systems. These benefit us either by cutting the amount of human input needed to employ fewer personnel, or by creating systems that operate beyond human limitations - for example at very high speed and precision.

But what does an autonomously operating technical system look like? According to Veres it has:

- Some modelling of a changing environment;
- learning various skills in feedback interaction with the environment;
- symbolic recognition of events and actions to perform logic-based computation;
- ability to explain reasons of own actions to humans; and
- efficient transfer of rules, goals, values and skills from human users to the autonomous system.

The last three of these five desirable technical features might be achieved with the natural language programming (NLP) sEnglish system, (stands for 'system English', and pronounced as 's-english') which enables shared understanding between machines and their users.

NLP is a method that builds up the functionality of a machine or an autonomous system using human concepts found in natural language sentences to express a system's procedures and logic. Each NLP sentence corresponds to a conceptual graph. Conceptual structures are formal descriptions of human thoughts – independent of language. NLP is the

simplest compromise between what feels like natural language and what is in fact computer programming.

The sEnglish system is already available so authors can publish self-contained conceptual structures and procedure sentences in a natural language document in English in HTML and PDF formats. The authors can place these documents on the Internet for autonomous systems to read and share.

Looking forward, Veres sees the intelligent system discuss its potential upgrades with its users, lifting this burden from users and manufacturers. Long after their sale, machines will read technical documents from the Internet to improve their performance. These documents can be published not only by their original manufacturer but by user communities.

"The adoption of a 'publications for machines' approach can bring great practical benefits by making the business of building [autonomous systems](#) viable in some critical areas where a high degree of intelligence is needed and safety is paramount," says Veres. "In these areas publications for machines can help develop the trust of customers and operators in what the machines do in various environmental situations."

More information: *Proceedings of the Institution of Mechanical Engineers*, Part I: Journal of Systems and Control Engineering July 15, 2011 [doi: 10.1177/0959651811408502](https://doi.org/10.1177/0959651811408502)

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