

# NOBLIS PIECES OF EIGHT (PO8)

## AUTONOMOUS VEHICLE INTEROPERABILITY CONCEPT

The Noblis Po8 concept orchestrates the motions and actions of unfamiliar, connected, and autonomous machines. With this concept, systems of autonomous machines are safer, more productive, and more equitable.

The Noblis Pieces of Eight (Po8) system enables nearby connected machines to share situational awareness of obstacles and threats projected over time. It allows them to collectively plan motion paths and other actions that avoid collisions or conflicts. This interoperability permits high-speed motion and coordinated actions which are impossible without advance knowledge of all the localized actions.

Further, the Po8 system supports a collective post-hoc accountability process to assess the reliability of each individual machine to act faithfully in accordance with collectively optimized motion paths and actions. An individual machine establishes a track record within the Po8 system (secured using a blockchain) so that the reliability of the machine to faithfully follow collectively assigned motion/action paths in the past may be factored into the representation of the collective uncertainty map and the current set of optimized motion/action paths.



*“Po8 allows pick-up teams of autonomous machines to perform as if they have trained together extensively,” said Karl Wunderlich, Noblis research team lead.*

*“Further, if one machine in the system malfunctions or begins to perform erratically, the team will self-organize to re-assign critical team functions and isolate the compromised machine.”*

### THE PO8 SYSTEM HAS FIVE FUNDAMENTAL ELEMENTS:

1. Collective situational awareness realized in a normalized local obstacle and threat map with uncertain contours. This element normalizes diverse sensor technologies into a single shared local dynamic map that explicitly considers the past reliability (earned trust) of individual machines.
2. Optimization of collective motion/action traversing uncertain contours reconciling potential conflicting motion paths or actions among all machines and cognizant of the reliability (earned trust) of individual machines.
3. A value distribution by contribution method ensures equitable remuneration to/from machines receiving/granting priority and to machines that assist in identifying dynamic obstacles. This element specifically incentivizes machines to contribute to key Po8 ecosystem functions.
4. Post hoc individual accountability assessment where all machines assess the ability of nearby machines to act and move in accordance with collectively determined motion/action paths.
5. Earned trust accounting and reporting for each individual machine in an open consortium blockchain distributed ledger to ensure transparency, accuracy, and security of the Po8 system.

## DEMONSTRATING PO8: THE ROBOT DERBY

The Robot Derby demonstration is an early physical realization of the Po8 concept and prototype system. In this demonstration, multiple autonomous robots are given repeating (and naturally conflicting) paths to navigate simultaneously in a constrained physical environment. Myopic motion path planning (no orchestration) results in slow collective progress as the individual robots attempt to avoid each other using passive detection. Connecting the autonomous robots to the Po8 system allows collective obstacle detection and motion path planning, so faster movement is possible. As the machines interact and learn, earned trust in the system rises, allowing progressively faster speeds. A monitor to the side of the demonstration shows how the blockchain builds earned trust scores for each machine and measures the speed of robot circuit completion.



## AWARD WINNING CONCEPT



Noblis' Po8 Orchestrated Autonomy Concept won the Highest Potential Impact Award and the Most Creative Award at the MOBI Grand Challenge Phase I in Munich, Germany (February 2019).

Noblis' Po8 Orchestrated Autonomy Concept ranked first for "Most Creative" and "Highest Potential Impact" - and second in the "Overall Category" at the MOBI Grand Challenge Phase II in Los Angeles, California. (November 2019).



Po8 was chosen as an Industry Innovation Winner by Washington Technology / 1105 Media as part of the Government Innovation Awards showcase which recognizes the best examples of discovery and innovation in government IT (September 2019).

Watch our videos to learn more about Po8:



**Po8 Concept**  
[bit.ly/po8video1](https://bit.ly/po8video1)



**Sustainable Po8**  
[bit.ly/po8video2](https://bit.ly/po8video2)

## NOBLIS SPONSORED RESEARCH (NSR) PROGRAM

The NSR program is a vital and essential part of corporate life at Noblis. Our yearly investment in this program, along with our ethical practices and code of conduct, is part of what makes us the unique nonprofit organization that we are. Noblis research is the forward-thinking seed that generates not only larger corporate work programs and roles, but also sound, sustainable solutions with enduring impacts.

Noblis is a nonprofit science and technology organization with a reputation for independent objectivity that brings the best of scientific thought, engineering expertise, and strategic management. We work with a wide range of government and industry clients in the areas of national security, intelligence, transportation, healthcare, environmental sustainability, and enterprise engineering. Together with our wholly owned subsidiary, Noblis ESI, we solve difficult problems of national significance and support our clients' most critical missions.