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Networked Robots: A Brief Look at Possible Legal Implications

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NETWORKED ROBOTS: A BRIEF LOOK ON ITS POSSIBLE LEGAL IMPLICATIONS

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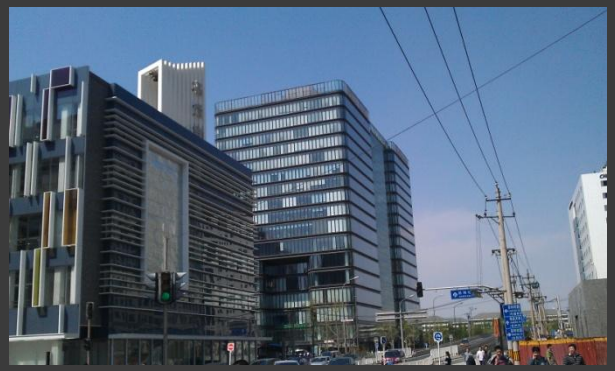
Peking University Law School, Beijing

Peking University Law School is the institution with the longest history of modern legal education in China. Its precursor was the Law Department of Peking University, which was founded in the year of 1904. Peking University Law School has a strong reputation in the legal circle of China.

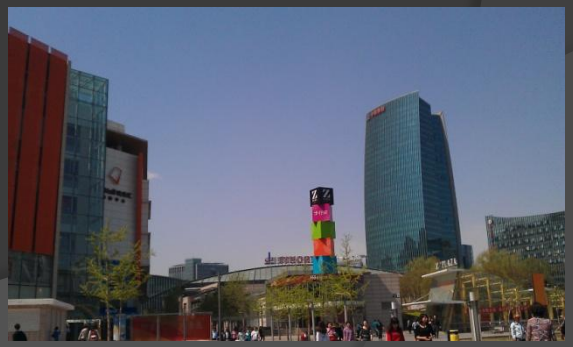
PKU-Yahoo! Internet Law Center

With the support of Yahoo! and Peking University Founder Group, the establishment ceremony of Peking University Law School Internet Law Center was held at Peking University on April 14, 2004. Representatives Jerry Yang from Yahoo! and WeiXin from Founder Group attended the ceremony. The center has close contact with the government and industries, it focuses on researching the legal and policy issues that are faced in the development of internet at home and abroad, and research projects are formed on the basis of interactions.



Outside View

Inside View



Located in Beijing's Zhongguanchun Area

Why we are concerned about “Robotics & Law”?

- When RT starts integrating into society, Safety 、Policy 、Ethics 、Law are all necessary issues for building a Robot Society.
- These four issues are relevantly connected together.
- How to regulate the risk caused by “Automation” in an open world (unstructured environment) is a new challenge in the legal field.

- Part-1: Cloud-Enabled Networked Robotics

Cloud Computing

- Google formally introduced the term "cloud computing" in 2007, therefore opening the era of cloud computing.
- The goal of cloud computing is for computing, service, and application to become as easily obtainable as resources like water and electricity.
- The features of cloud computing service include:
  - Dynamic
  - Scalable
  - Virtual

Cloud-enabled Networked Robots

- The significant impact it has on networked robotics is the strong middleware platform it provides.
- **RoboEarth:** a recent European project has begun to develop a globally-accessible WWW styled database. It is designed for sharing among robots information required for object recognition, navigation and task completion in the real world.
- This framework helps robots to learn about and adapt to unstructured environments.

Cloud-enabled Networked Robots

- **Other potential benefits to robots from cloud computing include:**
  - (1) Outsourcing of computing power .
  - (2) Acquisition of new skills directly from the cloud.

- Carnegie Mellon professor and Google robotics researcher James Kuffner summed up the benefit for cloud computing to improve robotics, saying *that* "***Embracing the cloud could make robots 'lighter, cheaper, and smarter.'"***

Cloud-enabled Networked Robots

- However, the networked robots we focus on is cloud-enabled robotics supported by cloud computing, it is very different from tele-presence robotics operated by signal transmissions.
- Cloud-enabled Networked robots are operated through transmissions of the Internet, which is not under the designer's control.

- **Tele-bots:** networked robots dependant upon signal transmissions.
- **Ubi-bots:** networked robots' autonomous behavior dependant upon "network".

- Part-2: Open-Texture Risk in Cyberspace

Intelligence Derived From The Network And Its Risks

- The openness of cyberspace has led to innovation; innovation facilitated massive “linkage” and self-developed “intelligence”.

- As Google’s vice president Vinton Cerf observes regarding the Internet,

  “*Virtual and real worlds will merge. Virtual interactions will have real world consequences. Control of the electrical grid and power generation systems could be made to appear to be part of a virtual environment in which actions in the virtual space affect actions in the real space.”*

Open-Texture Risk

- Risk assessment can measure machine risk in order to design mechanisms for achieving approved safety levels. Unfortunately, this regulation model does not fit well with the safety requirements of intelligent robots.
- **Robot safety problems can be divided into risks from machine standards and risks from autonomous behavior.**
- Open-Texture Risk: Risks that are derived from autonomous behaviors, and cannot be covered by the safety standard. (Y.H.Weng, et al., 2007)

Open-Texture Risk in Cyberspace

- Our definition of open-texture risk in cyberspace is based on two factual elements:
- First is “the autonomy of the robot”.
- Second is “the autonomous effectiveness of physical production”.

Open-Texture Risk in Cyberspace

- Ubi-bot in cyberspace is much more accessible than tele-bot in cyberspace, ubi-bot in autonomy interacting with the internet will cause open-texture risk in cyberspace,
- Open-Texture Risk will soon become a inevitable problem in cyberspace.
- Uncertainty in automation will expand from the physical world to the interlacement of physical world and cyberspace.

Open-Texture Risk in Cyberspace

- Ubi-bot as a significant example, will have the following two main issues:
- **(1) Larger Range:** stand-alone robot risk transforms to potential risk in a large group of robots, so it is harder to define.
- **(2) Deeper Impact:** mistakes in this virtual world will cause threats in the physical world.

- Part 3: Legal Issues On Cloud-enabled Networked Robots

Legal Issues On Cloud-enabled Networked Robots

- Privacy:
- For autonomous robots in urban areas, the collection of environment information will inevitably mix in [acquire] personal data. (A. Sanfeliu, et al. 2009)
- For networked robots, “network” will increase the risk of personal data, for example:
  - Downloading “world model”.
  - Downloading previous experiences and skills.

Legal Issues On Cloud-enabled Networked Robots

- Resource Distribution:
- In contrast with the privacy protection issue, some information should remain “Free and Open”
- Some of the data, however, might be related to the **Greater Public Good**, such as information from the prior experiences of rescue robots.
- From a regulator’s perspective, it is necessary to consider whether this kind of information should be “Open Access.”

Legal Issues On Cloud-enabled Networked Robots

- Liability:
- There are different views regarding the liability of physical damages by robots. Salvini defines robots as a type of property, and liability is divided into two parts. (P. Salvini, et al., 2010)
  - The first is to compensate directly by the manufacturer (based on error in manufacturing or design of the product)
  - The second is the manufacturer can plea against the user (based on third party misuse of the robot)
- This model can usually solve the problem of the liability on general intelligent robots.

Legal Issues On Cloud-enabled Networked Robots

- Liability:
- But for networked robots, which itself is an open platform, on this platform involves many parties including robot hardware manufacturers, software service providers and network service providers. These are bound to increase difficulty in distribution of responsibilities.

- Definition of **Open Robotics** (M.R. Calo, 2011)
  - 1. Multifunctional
  - 2. Nondiscriminatory
  - 3. Modular

Legal Issues On Cloud-enabled Networked Robots

- Liability:
- There are three main problems for liability from the "**Openness**" of networked robots.
- Foreseeability: Performance is much more unpredictable

  This will lead to a disincentive for robot manufacturers to produce safe robots; the third party misuse defense will be invalid. (M.R. Calo, 2011)
- Virtual and Real World merge together, damage is hard to determine, especially between Cloud Service Provider and Manufacturer.

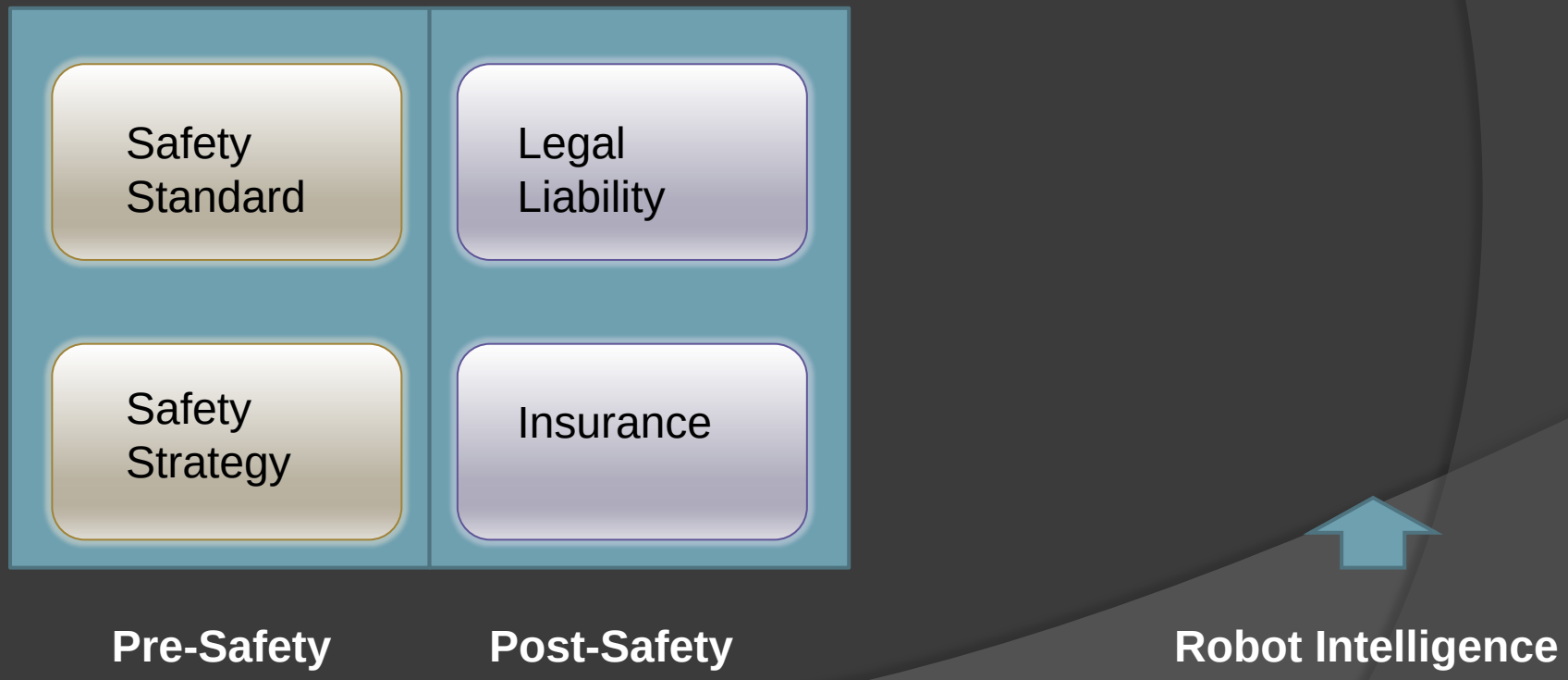
Legal Issues On Cloud-enabled Networked Robots

- Liability:
- Time Delay will make outsourcing computing power become a major dispute for Cloud-Enabled Networked Robots.
- Not only is this an open-texture issue, it also faces a dilemma.

- Part 4: Long-term Consideration: On Safety Intelligence for Networked Robots

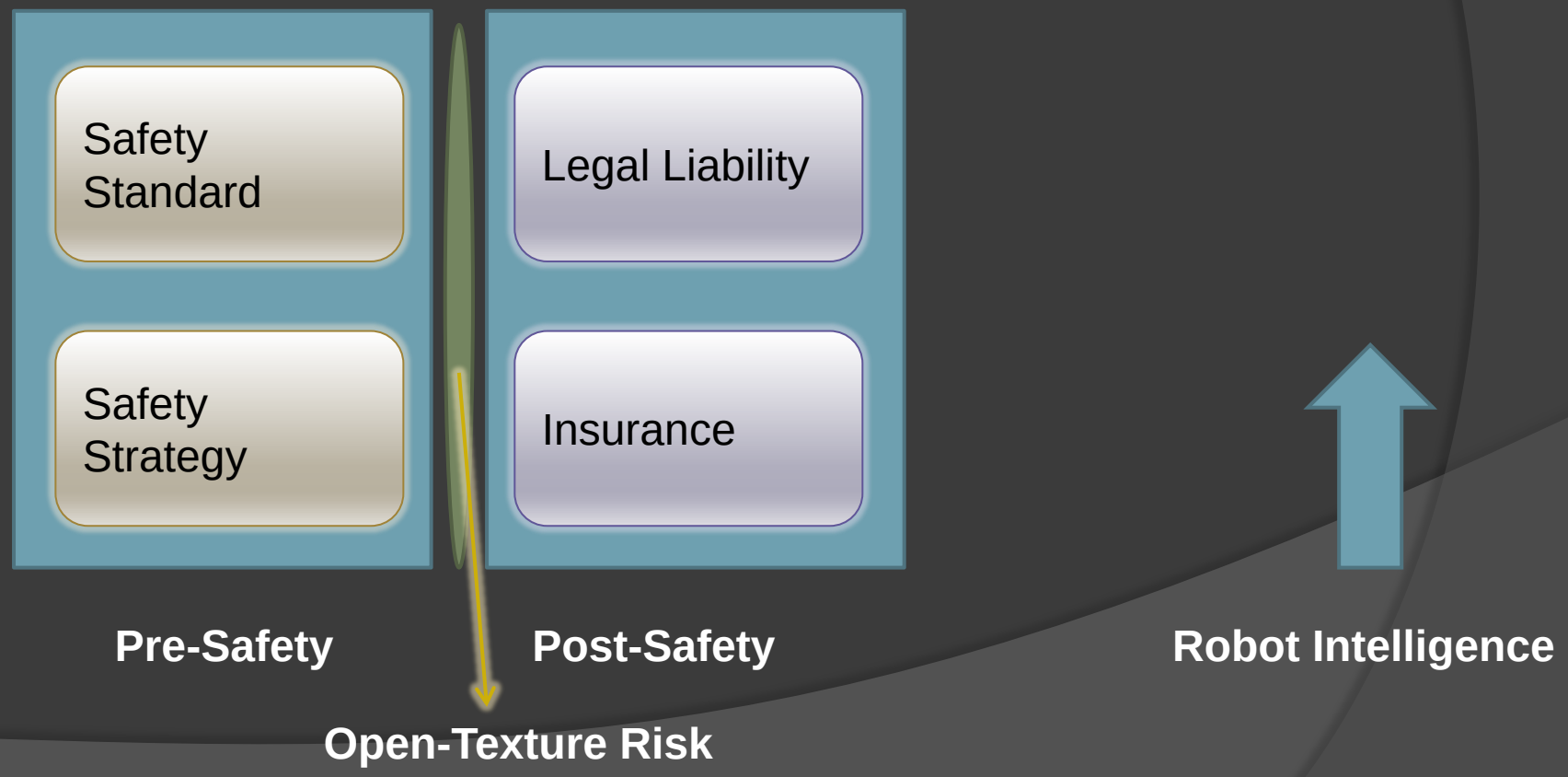
Open-Texture Risk & Robot Safety

- Current Robot Safety System



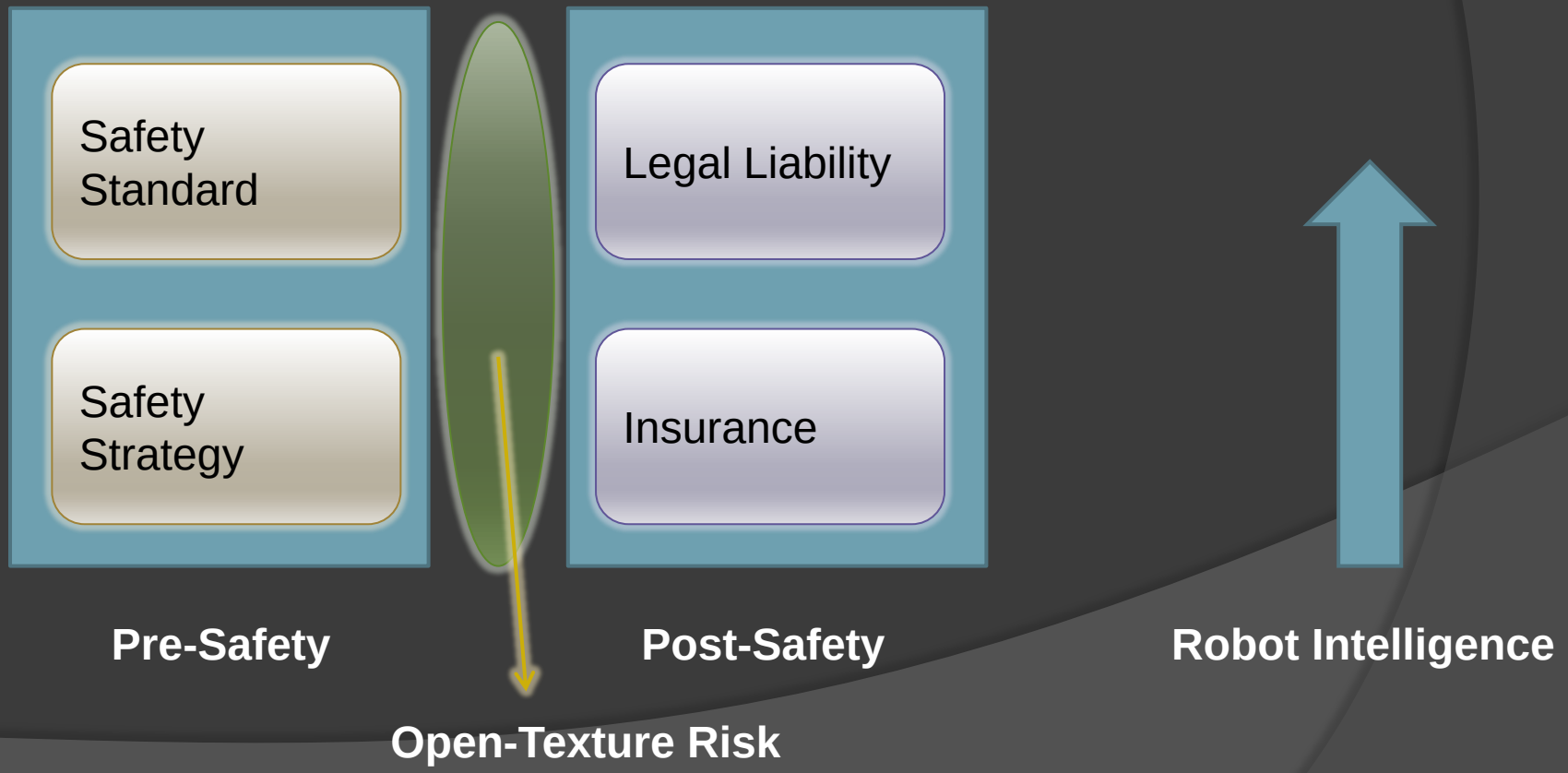
Open-Texture Risk & Robot Safety

- The risk gap between pre-safety and post-safety still exists



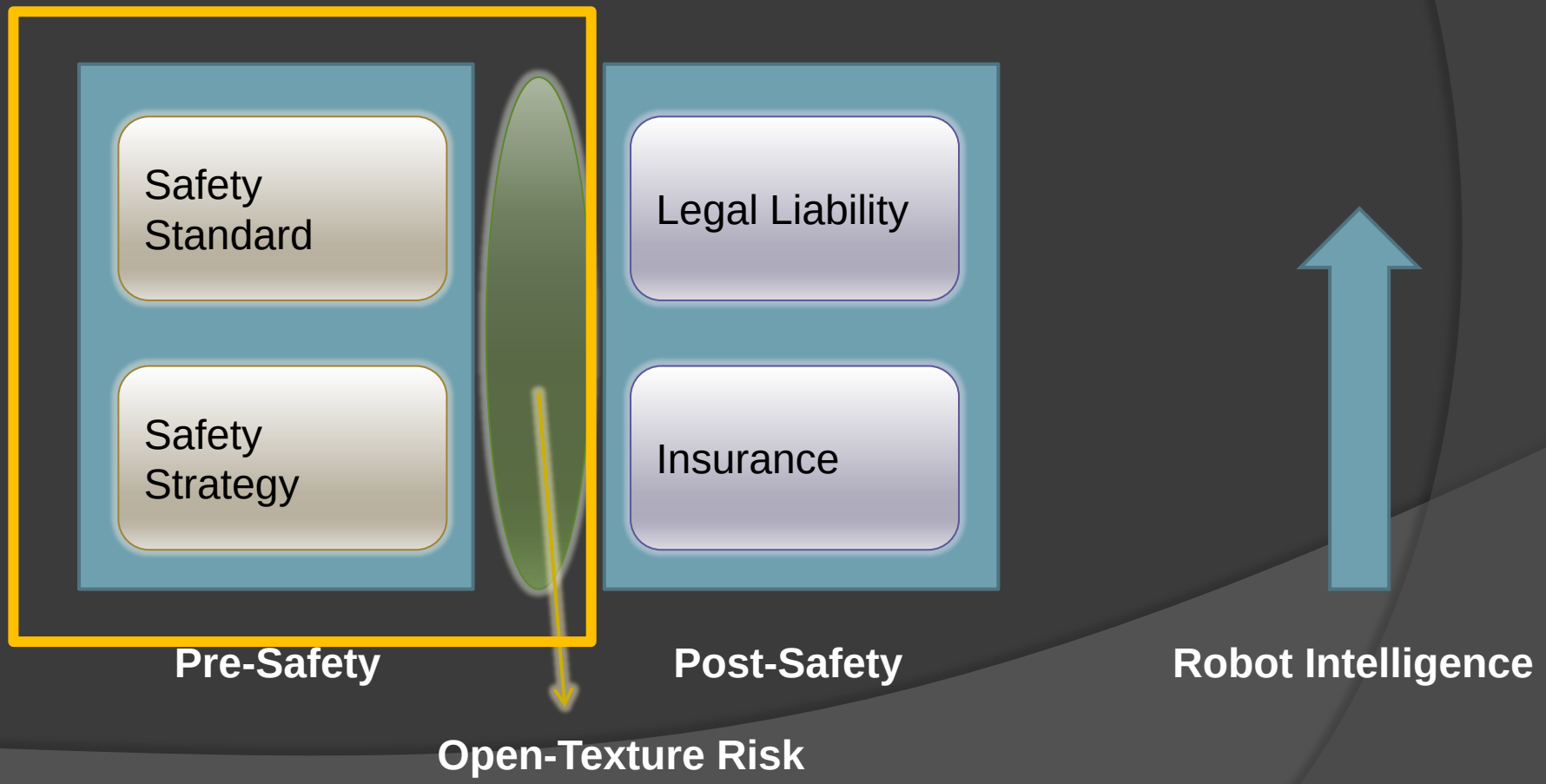
Open-Texture Risk & Robot Safety

- Furthermore, this risk gap will increase continuously according to the development of robot intelligence in the following decade.



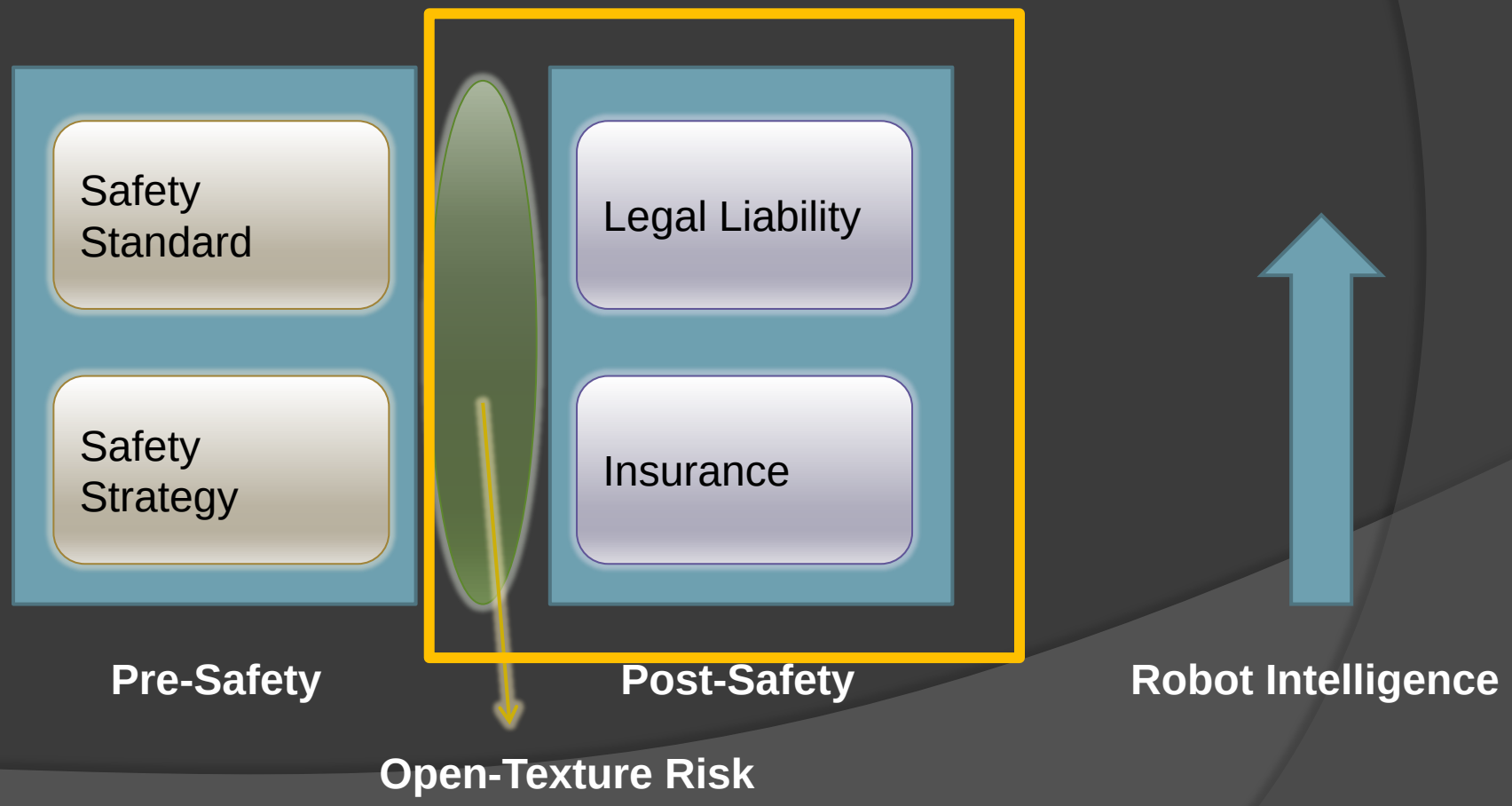
Open-Texture Risk & Robot Safety

- Solution 1: Keep in Pre-Safety



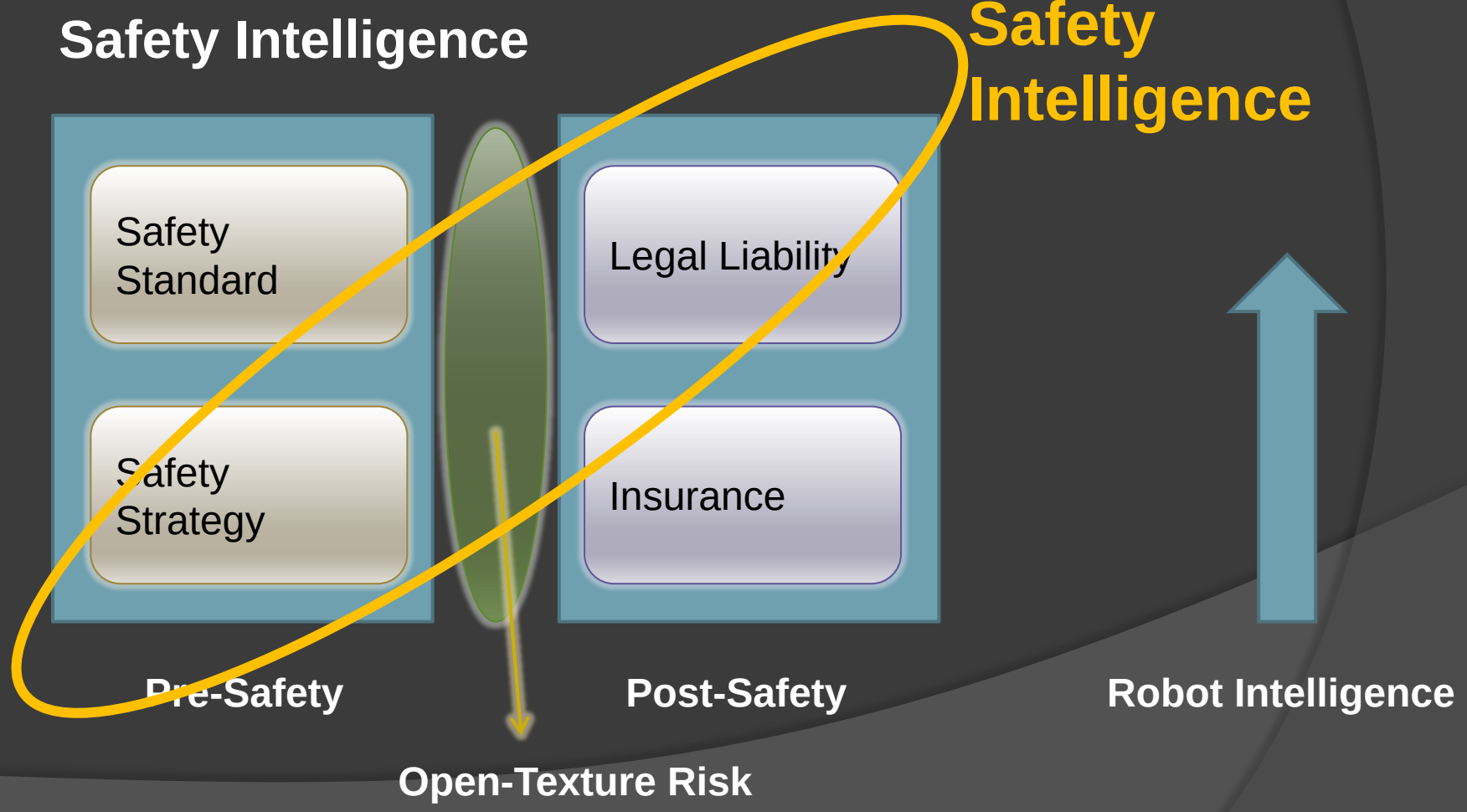
Open-Texture Risk & Robot Safety

- Solution 2: Keep in Post-Safety



Open-Texture Risk & Robot Safety

- Alternative Solution:
  Safety Intelligence



Code: and Other Laws of Cyberspace

- **“Code is Law”** Because of the special nature in cyberspace, Lawrence Lessig believes that code is a more effective control than law, and calls this “code is law”. (L. Lessig, 1999)

- **Legal Machine Language** (Y.H. Weng et al, 2008) will be a practice possibility for safety intelligence. For example, for the ubiquitous feature of networked robots, as long as controlled through the network, it will be able to reach the control of robots in the real world.

Conclusion

- The integration between real world and virtual world makes the Open-Texture Risk derived from autonomous networked robots larger and deeper and leads to legal issues such as privacy protection, liability for physical harm, and public resource distribution.

- With the robotic technology coming into the market, legal control over the issues will become increasingly important.

- Because RT is a complex and frontier issue, the cooperation of the robotic world and legal world will be a premise in establishing Human-Robot Co-Existence Society.

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