

M EQUIPMENT



MEDICAL ROBOTS



Surgery

Rehabilitation

PERSONAL CARE ROBOTS



Personal care robots

INDUSTRIAL ROBOTS



Industrial robots

MILITARY



Robot Ethics

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- **Technology development**
 - **Design accounts for implications to society, economy, application and environment, from safety and performance perspectives**
 - **Design constrained; dictated by standards and regulations**
 - **Standard's perspective => proper risk assessment required**
- **Ethics form a further dimension of technology development**
- **Ethical assessment needed at design stage; analysis and estimation of ethical disturbance that may be caused**
- **Misuse of robot, however, is down to responsibility and moral obligation of user; governed by regulations**

- **The UK Robot Ethics Forum has classified the set of ethical issues into four main categories; societal, application, commercial/Financial and environment**
- **Societal issues**
 - **Privacy and confidentiality**
 - **Respect for human dignity and human rights**
 - **Respect for cultural diversity and pluralism**
 - **Dehumanisation of humans in the relationship with robot**
 - **Responsibility and legal issues**
 - **Benefit and risk balance**
 - **Informed consent**
 - **Anthropomorphisation of the robots**

- **Application issues**

- **Design principles and requirements (qualitative)**

- Scale for specific application scenario
- Performance level requirements also qualitative => define levels of autonomy e.g. as acceptable and not acceptable

- **Rehabilitation and medical applications**

- Physiotherapy augmentation of human => control by human, replacement of professional
- Loss of certain skills with robot doing the work

- **Care applications**

- Child-minding and elder care robots
- Lack of human care and attention with long exposure
- Effect on character development of child, and social isolation of elderly

- **Military applications**

- Development for combat is of serious concern; discrimination of friend & enemy
- Some ethical issues contained into the command and control framework; commanders held responsible

- **Commercial/financial issues**
 - **Industry exercises cost-benefit models; some may lead to ethical issues**
 - **Engagement with industry required**
 - To ensure ethically accepted products are manufactured
 - Allow development of suitable ethical business models
 - **Embody standards development process with ethical consideration**
- **Environmental issues**
 - **Previous studies have considered sustainable development**
 - **Use of environment-friendly material in robot development**
 - Scarce materials, bio-degradable (graceful and harmless degradation)
 - **Exercise sense of responsibility towards biosphere => life-cycle considerations**

Guidance/Standard Development Approach

- **There are diverse range of cultural and regional perceptions and expectations**
- **To allow address these a generic approach of systematic nature is adopted**
 - **Determination of ethical issues (engage with designers, developers, end-users)**
 - **Determination of ethical hazards as related to the identified issues**
 - **Determination of ethical risks associated with the identified ethical hazards**
 - **Measures to mitigate the ethical risks**
- **A viable approach that matches the development of safety and performance technology standards at the ISO and IEC**

Conclusions



- **Guidance and regulatory framework needed for robots to be ethically compliant during their life-cycle**
- **Standardization is vital for ensuring safety and interoperability for the future success of the needed service robot product markets**