

# Science and Technology in Defence and National Security: Trends and Impacts

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# Overview

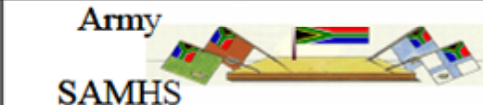







- General patterns of technological evolution
- From nano to systems
- Impact on the nature of war and conflict

# General Patterns of Technological Evolution

- S curve and industry dynamics
- Uneven development of the parts
- Towards more useful functions, less harmful
- First at lower level in hierarchy, then to next higher level
- Science and the tools of science progress together
- Engineering and the tools of engineering progress together

# Systems Innovation

- Innovation is at work at all systems levels
- Most often best impact for investment higher in systems levels

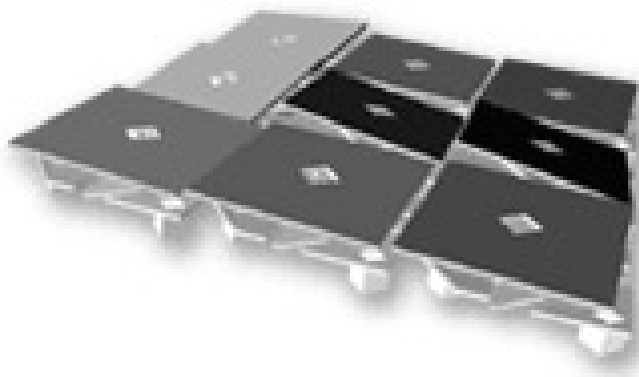
System	Level	Explanation
Operational Force	8	
Combat Grouping	7	
User System	6	
Product System	5	
Product	4	
Product Sub-system	3	
Components	2	
Materials/ Processes	1	

# Evaluation of global technology trends

- Miniaturization
- Sensors
- Precision weapons
- Protection
- Unmanned Systems
- Complex Systems

# Miniaturization

- Nanotech, Moore's Law, and MEMS
  - Nano-particles, nano-machines
  - Micro Electro Mechanical Systems
  - Semiconductors and Moore's Law
- Implications
  - New materials with new properties, new coatings
  - More functions in same volume, memory, computing power
  - Faster, more efficient devices
  - New types of devices



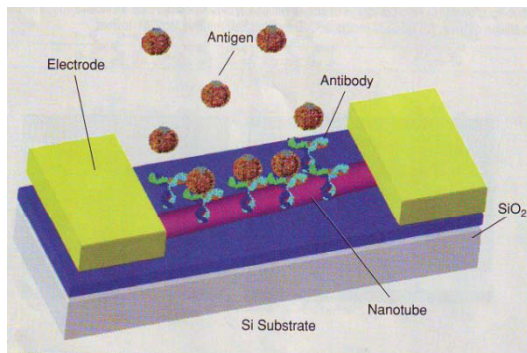
# Biological Sciences

- Biological information availability
- Biomedical Engineering
- Genetically Modified Organisms
- Biomimetics
- Rational Drug Development
- Synthetic Biology



# Sensors

- Small sensors, energy harvesting, communications built in
- “Lab on a chip”
- Biometric sensors, sensors for detecting CBRN molecules
- Higher bandwidth, waveform agility
- Improved control over waveforms
- Able to extract more information about the object of interest





# Precision weapons

- High precision sensors for guidance, stabilization, detection, tracking, navigation
- More precision using less power and volume
- Intelligence and precision into smaller weapons, munitions
- Adjustable weapons effects

# Protection

- Must avoid detection at all cost !
- RPG with explosively formed projectiles (EFP), improvised explosive devices in the form of EFP, reactive armour or precision weapon (missile) or new material/structure (passive)
- Protection against ballistic weapons
- Electromagnetic spectrum
- Chemical, Radiological, Nuclear, Biological
- Cyber Defence
- Protection of national infrastructure

# Unmanned Systems

- The biggest single area of investment in Defence R&D internationally
- Benefit from miniaturization
  - More sensors, enhanced sensors, lower volume, lower weight
  - More on-board computing power, more intelligent, more autonomous
  - Longer missions, ubiquitous capability
  - New challenges
- Applications in Land, Air, Sea
- Land applications the next frontier

# Complex Systems

- Intelligent, cognitive systems, high connected, adaptive networks, internet, cyber security
- Internet of things
- Geo-information systems, strategic information systems for resource management (including log)
- Sensor networks, networks of simple to advanced sensors
- Opportunity for significantly enhanced coordination
- More complex national systems: telecommunications, banking, transport, electricity distribution, water distribution
- Systems resilience a concern

# Impact on the nature of war and conflict

- Conventional Warfare
  - Ubiquitous Wide Area Surveillance
  - Network Centric Warfare
  - Precision Warfare
  - New principles of war for the information age
- Asymmetric Warfare
  - Rise of non-state actors
  - Open Source Warfare
  - Systems Warfare

# EU FP7 Security Research Program

<b>Activity 10.1: Increased Security of the Citizens</b>	<b>10.1.1 Fight against organized crime</b> <b>10.1.2 Fight against terrorism</b> <b>10.1.3 Explosive threat</b> <b>10.1.4 Ordinary crime and forensics</b> <b>10.1.5 CBRN protection</b>
Activity 10.2: Increasing the Security of Infrastructure and Utilities	10.2.1 Design planning and building and urban areas 10.2.2 Energy Transport and Communications Grids 10.2.3 Surveillance 10.2.4 Logistics and Supply Chain
Activity 10.3 Intelligent Surveillance and Enhancing Border Security	10.3.1 Sea borders 10.3.2 Land borders 10.3.3 Air borders 10.3.4 Border checks 10.3.5 Border intelligent surveillance
Activity 10.4: Restoring security and safety in case of crisis	10.4.1 Preparedness, prevention, mitigation and planning 10.4.2 Response 10.4.3 Recovery 10.4.4 CBRN response
Activity 10.5: Improving security systems integration, interconnectivity and interoperability	10.5.1 Information management 10.5.2 Secure communications 10.5.3 Interoperability 10.5.4 Standardization
Activity 10.6: Security and society	10.6.1 Citizens and security 10.6.2 Understanding organizational structures and cultures of public users 10.6.3 Foresight, scenarios and security as an evolving concept 10.6.4 Security economics 10.6.5 Ethics and justice

# Conclusion

- Miniaturization has a ripple effect
- New streams of miniaturizations are underway in nano and bio
- Innovation happens at all levels, many high level innovations underway
- Technological evolution causes evolution in the nature of war and conflict !

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# Thank You