Benefits analysis

Lesley Murphy
QinetiQ

ESA Space Weather Programme study
Final presentation, 6th-7th December 2001

Benefit categorisation

STRATEGIC - affecting Europe's industrial, military, technological and scientific independence

Benefit categorisation

STRATEGIC - affecting Europe's industrial, military, technological and scientific independence

ECONOMIC - affecting the price consumers must pay for services and the cost competitiveness of the business in which they work

Benefit categorisation

STRATEGIC - affecting Europe's industrial, military, technological and scientific independence

ECONOMIC - affecting the price consumers must pay for services and the cost competitiveness of the business in which they work

TECHNOLOGICAL AND SCIENTIFIC - affecting the development of new products and industries as well as pure and applied research

Benefit categorisation

STRATEGIC – affecting Europe's industrial, military, technological and scientific independence

ECONOMIC - affecting the price consumers must pay for services and the cost competitiveness of the business in which they work

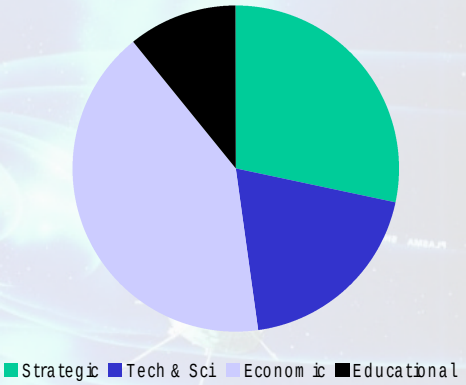
TECHNOLOGICAL AND SCIENTIFIC - affecting the development of new products and industries as well as pure and applied research

EDUCATIONAL - affecting people's understanding of science, space and how space weather impacts their lives

Number of benefits

Diagram indicates the relative *number* of separately identifiable benefits

Not to be interpreted as an indication of relative importance !



Key strategic benefits

- Reduced dependence on non-European resources for forecasting, warning, reporting and analysis of space weather effects and hazards
- Improved competitive advantages for pan-European organisations and businesses
- Improved effectiveness and independence of European defence forces
- Improved competitiveness of European industry through bringing together of expertise from a wide range of disciplines
- Opportunities for growth of European industries in high-technology fields such as information systems, space platforms, sensors, launch services and ground segment equipment
- Strengthening of relations with non-European nations through co-operation agreements, industrial partnerships and scientific exchange
- Strengthening of ESA's role in co-ordinating European space co-operation

Key technological and scientific benefits

- Opportunity to increase the robustness of technology, to optimise its performance and to understand its limitations
- Development of new sensors, new platform technology (eg. micro and nano-satellites) and new data handling technology
- Opportunity to monitor the effects of technology on the space environment
- Development of novel technologies that can exploit changes in space weather and, potentially, technologies which modify space weather phenomena
- Stimulation of basic science through improved data availability
- Improvement of physical modelling and use of data-driven models
- Improved resilience of scientific missions

Key economic benefits

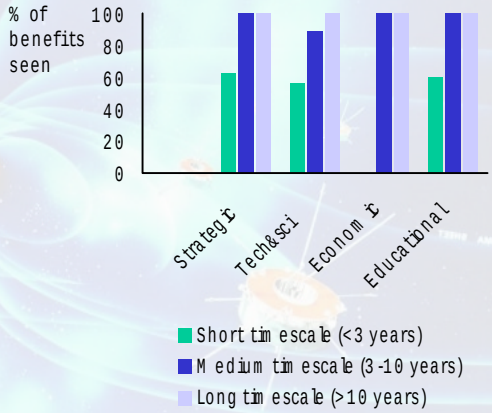
- Lower risk of disruption to terrestrial power grids
- More efficient use of HF and satellite radio communication systems
- Improved accuracy and reliability of global satellite navigation systems
- Reduction in risks to aircraft avionic systems
- Improved air and marine safety and defence through better use of radar systems
- Reduced satellite operations costs, increased satellite reliability and extended lifetime
- Greater launch reliability
- Improved competitiveness of spacecraft insurers
- Reduced radiation exposure of aircrew and astronauts giving reduced cancer risk, longer working life, reduced medical costs and lower risk of legal action

Key educational benefits

- Improved continuing professional development opportunities for scientists and engineers
- More opportunities to link the content of higher education courses in physics and astrophysics to practical experience from space missions and measurements
- Improved awareness of basic science and space issues among school students
- A stronger presence for European space activities on the World Wide Web giving greater visibility to the world at large

Timescales for benefit realisation

- Short-term benefits may accrue during the development phase, prior to operational use of any new assets
  - no significant economic benefits in this timescale
- Medium-term benefits could start to be seen as soon as new assets become operational
- Long-term benefits are dependent on further developments in space weather science or technology



Programme size impacts

Economic and educational

Extent of benefit likely to increase in proportion to programme size; some benefit will be seen even with a small programme*

*A small programme is defined as one in which only existing space resources are utilised

Programme size impacts

Economic and educational	Extent of benefit likely to increase in proportion to programme size; some benefit will be seen even with a small programme*
Technological & scientific	Some benefits (about 1 in 3) are dependent on use of hitchhiker spacecraft and/or procurement of dedicated space weather spacecraft; these would not be realised with a small programme

*A small programme is defined as one in which only existing space resources are utilised

Programme size impacts

Economic and educational	Extent of benefit likely to increase in proportion to programme size; some benefit will be seen even with a small programme*
Technological & scientific	Some benefits (about 1 in 3) are dependent on use of hitchhiker spacecraft and/or procurement of dedicated space weather spacecraft; these would not be realised with a small programme
Strategic	Some benefits (approximately 1 in 4) would not be realised with a small programme; others would increase in proportion to programme size

*A small programme is defined as one in which only existing space resources are utilised

Conclusion

A European Space Weather Programme could generate significant benefits within a relatively short time and extensive benefits in the long term