

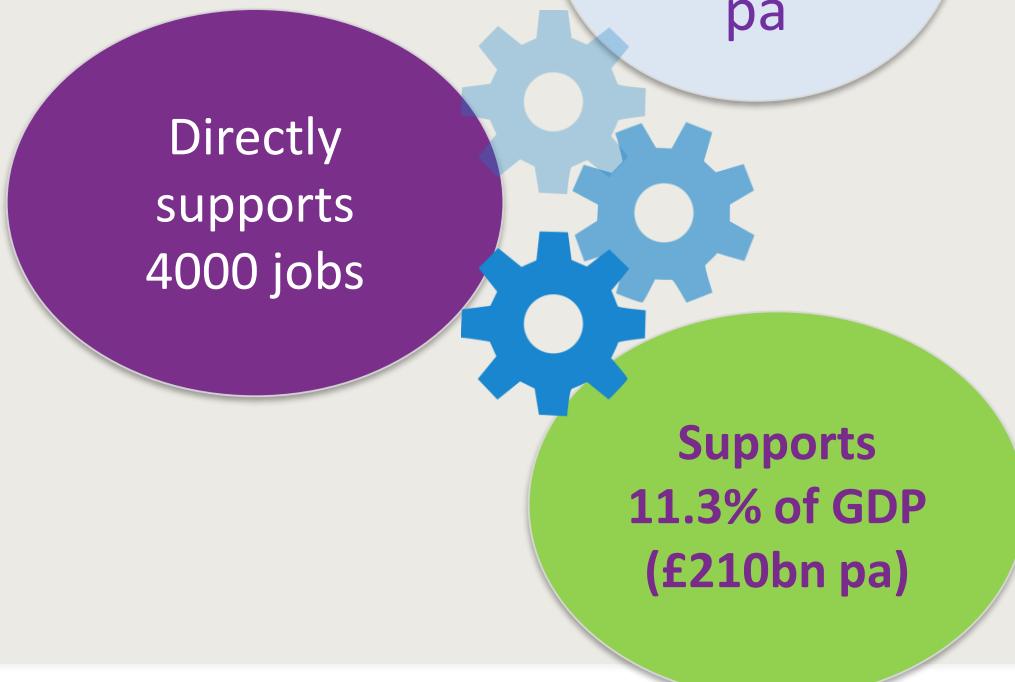
How critical is satellite derived location?

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GNSS in the UK



Research Objectives

- Identify sectors using GNSS
 - What is the economic benefit that GNSS technology and services bring to the UK?
 - Estimate the economic impact to the UK (government and private sector) of a disruption to GNSS functionality of up to five days
 - Identify the cost and effectiveness of mitigation strategies.
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- High-level assessment of the impact of UK public funding of GNSS

What would be the economic impact on the UK through the loss,
howsoever caused, of GNSS, for **up to five days?**

Why 5 days?

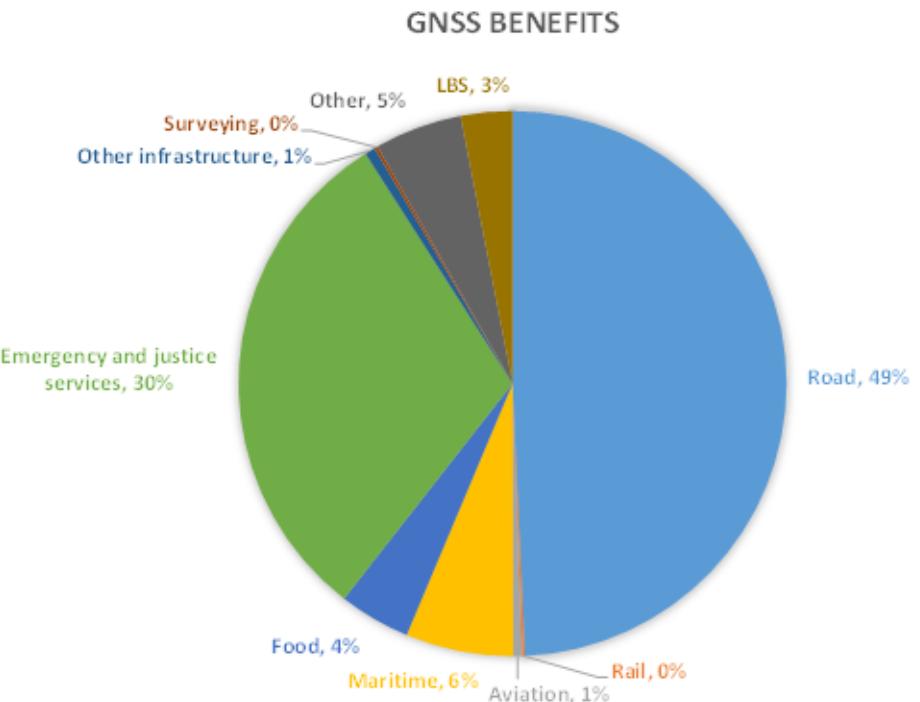


Image: NASA (2014)



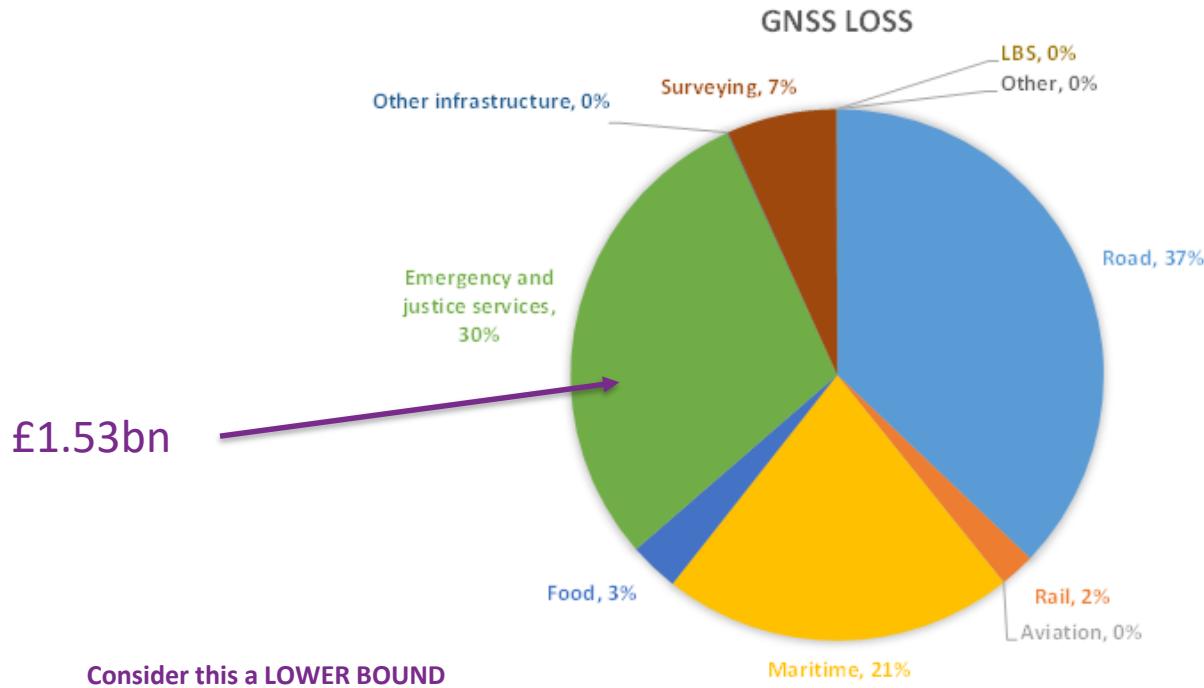
Economic Benefits of GNSS

- Quantified **economic benefits** to the UK of GNSS have been monetised at **£6.7bn per annum**, comprised of £1.2bn in Gross Value-Added (GVA) benefits and £5.5bn in utility benefits (efficiency, safety, etc.)
- Conservative estimates
- Cannot monetise all benefits
- Consider this a **LOWER BOUND**



Impact of Loss of GNSS (for 5 days)

- The economic impact to the UK of a five day disruption to GNSS has been **estimated at £5.2bn**.



Identify Mitigations and possible costs (not shown)

Technology	Potential Coverage	2D/3D Positioning	Accuracy
eLoran	National / Global	2D	10-20m – improving to 5m with eDLoran
Locata	Local / Regional	3D	<1cm
Omnisense S500	Local	3D	20cm-2m
Iridium STL service	Global	3D	Horizontal: 20m-50m unassisted and 10m in augmentation scenarios (1σ)

Source: London Economics research based on sources referenced in this section.

In addition to the four positioning and navigation-relevant technologies, four additional technologies have been identified specifically for the Timing property of GNSS. Table 4 summarises the findings for all eight technologies that are discussed in turn in this section.

Table 4 Timing Accuracy of Mitigation Technologies

Technology	Accuracy
NTP timing servers (NPL)	$\leq 1\text{ms} - 30\text{ms}$
NPL MSF 60 kHz radio signal	10ms
PTP	10ns ($1*10^{-5}\text{ms}$) - 100ns (0.0001ms) – but dependent on network setup and clock used as a timing source
NPL-Time	100ns (0.0001ms)
eLoran	100ns (0.0001ms)
Locata	2.5ns ($2.5 \times 10^{-6}\text{ms}$) – potentially much better
Omnisense S500	100 μs (0.1 ms) – possibly up to 10ns ($1*10^{-5}\text{ms}$) in the future
Iridium STL service	Compatible with IEEE-1588 standards: 10ns-100ns

Source: London Economics research based on sources referenced in this section.

Impact of Public Funding

- Estimated societal benefits at between £4 and £5 per £1 of public investment.
- The UK has made a €1.5bn investment in GNSS since 2000.
 - Most of this investment (94%) impact in GNSS is strongly tied to the UK's benefits from the European GNSS programmes (EGNOS and Galileo).
 - The UK's **€94.9 million** downstream investments since 2000 have also unlocked significant benefits to end-users and the rest of society that would have been lost without UK funding
- Report presents a strong case for continued public investment in GNSS.

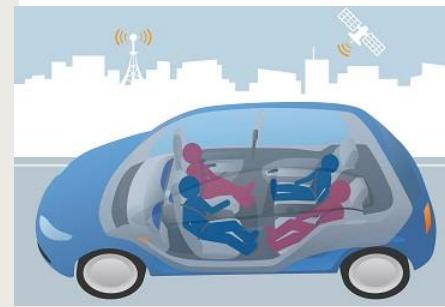
Summary

UK public funding returns
£4 - £5 for every £1



Use of complimentary technologies can reduce impact by £1.2bn

Economic Impact
of a 5 day loss of
GNSS to the UK
Est £5.2bn in 5
days
~£1bn per day



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