Intelligent decisions, intelligent infrastructure
...... The contribution of Geospatial and BIM.

Dr Anne Kemp
Director and Fellow, Atkins

Chair of AGI
Chair of ICE BIM Action Group
Chair of BIM4Infrastructure
AGI’s responsibility

- facilitate
- inform
- influence
What we have now

Where we are headed .......... our digital future
Whole Lifecycle IM

.... Start with the end in mind
...... For anything which is built
Its all about information

Better INFORMATION Modelling Management
Being information intelligent ..... requires information to be viewed in a holistic manner, balancing an appreciation of technologies with the capabilities of people within the business to harness and use the information to improve performance

(Marchand 2000)

A technical or an adaptive challenge?
## Contributions of Geospatial/BIM

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Integrated and collaborative working

Helps to:
- Collate
- Manage
- Integrate
- Analyse
- Visualise
Data Management and Use

Multi-Discipline Project

- Data is converted to accommodate different tools
- Multiple copies across the network
  - Same data – different format
Silos of technologies
Dis-aligned staff, software, data, standards, workflows
Integrated Data Management
Multi-Discipline Project

- Single source of truth used by all
- Data shared through common process and standards
Integrated technologies
Aligned staff, software, data, standards, workflows
1. Clarity of delivery
GIS Websites and Portals

Why use it?
- Central source of spatial data
- Access to data without any additional software requirements
- Reduced chance of using out of date data
- Elimination of time wasted by project staff spent searching for information
- Data viewed in context which can lead to better informed decisions
- Giving visibility to the client of project progress
http://marinescotland.atkinsgeospatial.com/nmpi/
BS 1192:2007

**Client Shared Area**

**SHARED**
Verified design data shared with the project team:
Ongoing design development

**WORK IN PROGRESS**
Non-verified design data used by in-house design team only:

- **APPROVED**
- **AUTHORIZED**
- **PUBLISHED DOCUMENTATION**
  - Coordination and validated design output for use by the total project team.
  - Production information suitable for Tender or Construction:

- **VERIFIED**
- **ARCHIVE**
  - Project history maintained for knowledge and regulatory and legal requirements.
  - Repository of the project information for non asset portfolio employers.
2. Converging information production with sound engineering judgement and design
Documentation History

- Pre1987 - No Electronic/CAD
- 1987 – Introduction of CAD
- 1997 – Some Major Projects still 2d with all hard copy contract documentation, no e-mails
- Olympics – All electronic
- 2013 – 2016 fully implement BIM
The Future – No BIM
The future collaborative BIM team

One Shared Version of the Truth

Lonely, limp BIM
Project Example — M4 Elevated section

- Services delivered
  - 103 piers over approx 2km
  - Data extraction from static and mobile point cloud
  - Plans, elevations and 3D wireframe model of piers and surrounding areas
  - Up to +/- 0.01m xyz
Future Proofing Lagos Energy

Why?
- Looking for alternative energy solutions

GIS applications during project
- High resolution imagery of industrial estates in Lagos
- Warehouse roofs digitally captured
- Potential solar output energy calculated using orientation and roof pitch

Image shows:
- Areas where there is a high potential of solar energy through the installation of solar panels
3. Wider, faster access to comprehensible and integrated information
Bristol Metrobus – GIS Analysis

Image shows:
- Bus Stops (orange)
- Metrobus route in North Bristol (blue line)
- 400m & 800m walking distances from bus stops (dark and light purple)

Overall plan to:
- reduce carbon emissions
- support sustainable economic growth
- promote accessibility
- contribute to better safety, security and health
- improve quality of life and create a healthy natural environment.
GIS Website – Example
4. Enabling reflective, adaptive thinking to incorporate whole life and integrated systems approach within the wider geographic context.
Federated Intelligent Infrastructure

Data developed throughout the life cycle

- Design
- Build
- Operate

Building – IM
Road – IM
Rail – IM
Utilities – IM
Bridge – IM
Sewer – IM
Survey – IM
Water – IM
Land – IM
Power – IM
Comms – IM
GIS – IM
Plant – IM
and many more
Asset Performance Portal
Example : Blockages and Jetting
MapAction Team Building Day
5. Harnessing innovative technologies and harvesting intelligence from big data
Photogrammetry
Two major challenges

Risk management
How do you ensure nothing is missed?

Cost
This is a very expensive problem
Lessons from other sectors

Array of data signals
Predictive
Real-time
Continuous
# Tackling risk and cost

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Hunting patterns

Spatial and temporal correlation between sensors means we can estimate missing readings.
Results

Working in partnership with Arup and Atkins

Validated on two years worth of data
Beyond infrastructure

Cities becoming more instrumented

Moving from construction to operations

Already extending techniques to airport performance and hospital design
6. Fostering instinctive but rigorous collaboration and better decision making
Site Selection

- Multi-criteria decision analysis
- Include multiple datasets in one single analysis
- Example datasets
  - Transport infrastructure
  - No fly zones
  - Military practice areas
  - Environmentally sensitive areas
  - Urban Areas
- GIS web map creation for use by key decision makers
Future cities

Future-proofing

Smart
Building Information Modelling (BIM) is transforming the way we design cities, buildings and systems to perform throughout their entire life cycle.
“The 19th century was a century of empires.

The 20th century was a century of nation states.

The 21st century will be a century of cities.”

Wellington E. Webb, former mayor of Denver
The World’s fastest-growing Mega-Cities
No. 1: Karachi, Pakistan
Population (Est.): 20.88 million
Population Growth, 2000-10: 80.5%
http://www.forbes.com
The World’s fastest-growing Mega-Cities
No. 2: Shenzhen, China
Population (Est.): 12.51 million
The World’s fastest-growing Mega-Cities
No. 3: Lagos, Nigeria
Population (Est.): 12.09 million
Population Growth, 2000-10: 48.2%
http://www.forbes.com
Challenges of the Future

• Scarcity of resources
• Inadequate and deteriorating infrastructure
• Energy shortages and price instability
• Global environmental “weirding” and human health concerns
What makes a City “smart”?

‘Smart’ holds the promise of finding new ways for citizens get the services they crave, without using exponentially more resources. The marriage of technology with the physical and built environment enables more efficient construction and management of infrastructure, and the potential to change behaviour for personal or public good.
From smart technologies to a **strategic framework**
Example


Example
If you can’t **measure** it, you can’t manage it

Measurement is key to the idea of smart.

Infrastructure, buildings and activities **reporting** their state and behaviour to systems that **learn and adapt** in response.

**Opportunities** arise from:

- Measurement, automation and feedback to decision-makers
  - short term benefits from crisis management
  - long term benefits from better planning

- Making both public and private datasets about the interaction between people, infrastructure and technology systems available to third-party service providers and developers.
Measuring city projects against a common set of metrics [1]
In 2005, 40 of the world’s leading mayors came together and made a commitment to work collaboratively to address one of the greatest economic, social and environmental challenges of our time.
And so to Big Data

‘Championing the value that the intersection of geography and information has for the economy, business and the individual.’
The Age of Industrial Revolution;
The Age of Information;
The Age of Knowledge;

.................. The Age of Wisdom????

“Knowledge Age knowledge is defined—and valued—not for what it is, but for what it can do.”

http://www.shiftingthinking.org/?page_id=58
Knowledge Age

Knowledge Age people …. need ‘know what’ kinds of knowledge.

However they need more than this. They need to be able to do things with this knowledge, to use it to create new knowledge.

……. it is a resource, something to learn (or think) with. In the Knowledge Age, change, not stability, is a given.
We live in a world saturated with information. We have virtually unlimited amounts of data at our fingertips at all times, and we’re well versed in the arguments about the dangers of not knowing enough and not doing our homework. But what I have sensed is an enormous frustration with the unexpected costs of knowing too much, of being inundated with information. We have come to confuse information with understanding.

“Blink” Gladwell 2007:264

The topic of information overload has been widely studied by academics from neuroscientists to economists. Economist Herbert Simon once said:

“A wealth of information creates a poverty of attention and a need to allocate that attention efficiently among the overabundance of information sources that might be able to consume it.”

McKinsey 2011

*Wilful Blindness*, Heffernan 2012

‘Championing the value that the intersection of geography and information has for the economy, business and the individual.’
Despite these apparent limits, there are ways to help organisations and individuals to process, visualise, and synthesise meaning from big data……

• more sophisticated visualization techniques and algorithms, including automated algorithms, can enable people to see patterns in large amounts of data and help them unearth the most pertinent insights

• Advancing collaboration technology also allows a large number of individuals, each of whom may possess understanding of a special area of information, to come together in order to create a whole picture to tackle interdisciplinary problems.

If organizations and individuals deployed such techniques more widely, end-user demand for big data could strengthen significantly.

McKinsey, 2011:18

‘Championing the value that the intersection of geography and information has for the economy, business and the individual.’
“The challenge lies in an organization’s ability to capture the big data that is applicable to its needs, effectively manage it, and extract new and relevant insights in order to achieve breakthrough business outcomes…” IBM (2013)

Crossrail project:
Collaboration of Arup, Atkins and Quantum Black (AAQB)

Lessons from other sectors

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Results

Working in partnership with Arup and Atkins
Validated on two years worth of data

‘Championing the value that the intersection of geography and information has for the economy, business and the individual.’
We can and do make split-second decisions on the most minute sets of data. Sometimes our bias in those moments can steer us astray, but when managed correctly, those “instant” decisions are not just as good, they can be better than those made in full conscious analysis of all available data.

The message is clear. If you can distil your decision making to just the right subset of the data and you prime yourself correctly, you can make better decisions with less information

So is THAT what we are asking as an output of Big Data analysts (whether human or computer)??

Delivering that crucial subset of information which supports the right people making the right decisions, at the right time, and in the right way????

That’s quite a responsibility………

have we enough people skilled to do this?

Championing the value that the intersection of geography and information has for the economy, business and the individual.

Being purposeful, and looking to move from 'intelligence' to 'response' (how do we deliver oring how smart cities can add value of smart. Infrastructure, buildings and behaviour to systems that learn and adapt in response.

Opportunities arise from:

- **Measurement, automation and feedback to decision-makers**, creating more efficient use of infrastructure, including buildings and roads, enabling both short term benefits from crisis management and long term benefits from better planning.
- **Making both public and private datasets** about the interaction between people, infrastructure and technology systems available to third-party service providers and developers.

‘Championing the value that the intersection of geography and information has for the economy, business and the individual.’
Areas to watch out for:

• Open – at what point do we stop sharing?
• Can you trust it?
• But what can we DO with it?
• Where is the boundary to our privacy?

• Is this really informing our decisions …… or making our decisions for us?
**Where we are headed ……… our digital future**

**Smart Cities**

“Being purposeful, and looking to move from 'intelligence' to 'response' (now we know this, what do we do about it) to 'capability' (how do we deliver that response on an ongoing basis)” – Simon Williams, Quantum Black

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