



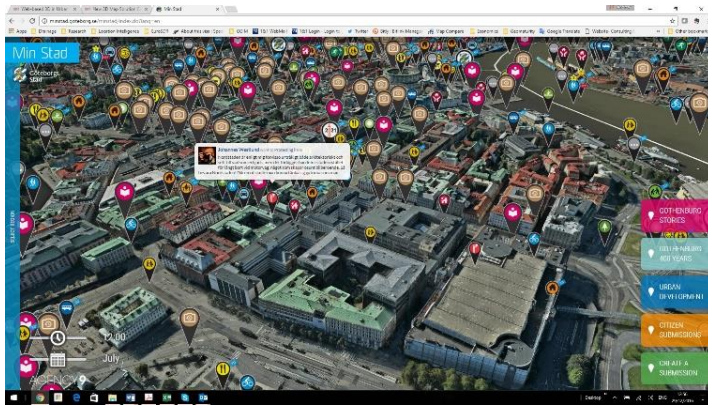
# Cost - Benefit Analysis

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## Urban Planning Results

# Urban Planning-driven City Model Projects

Gothenburg – citizen engagement



Helsinki – urban planning



Berlin – inward investment



Jersey – urban planning



# Approach to Economic Value Assessment

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1. Based on data from Republic of Ireland
2. Quantified only largest and most easily understood impacts
3. Conservative assumptions of benefits
4. Realistic estimates of costs, derived from NMA
5. Modelled financially over a 10 year period
  1. typical for infrastructure projects
6. Discount to Net Present Value (NPV) at 4%
  1. Current public sector recommendation for Ireland
7. Strengthened business case with qualitative description of non-quantified benefits

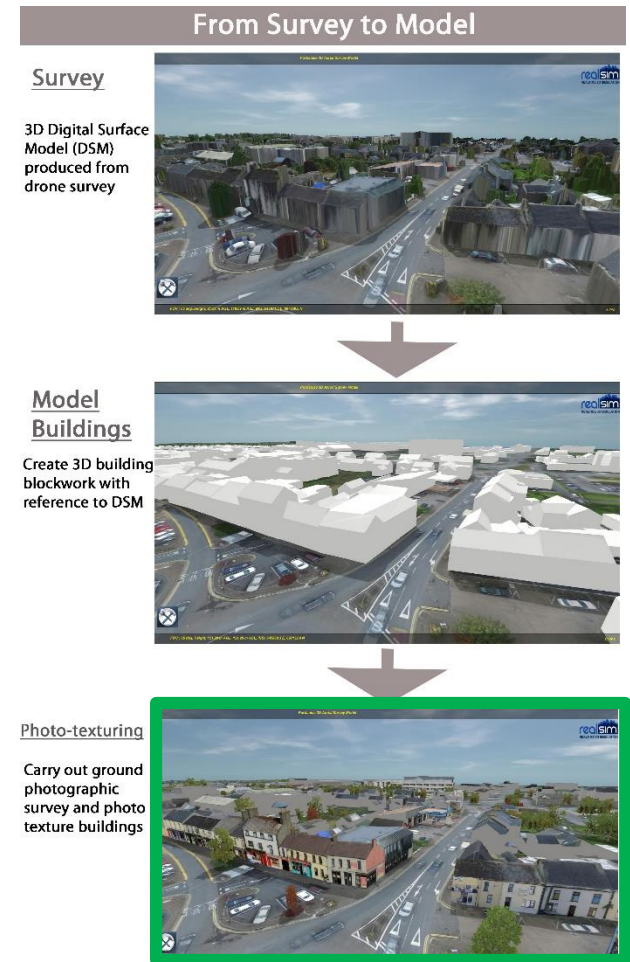
# Information Gathering

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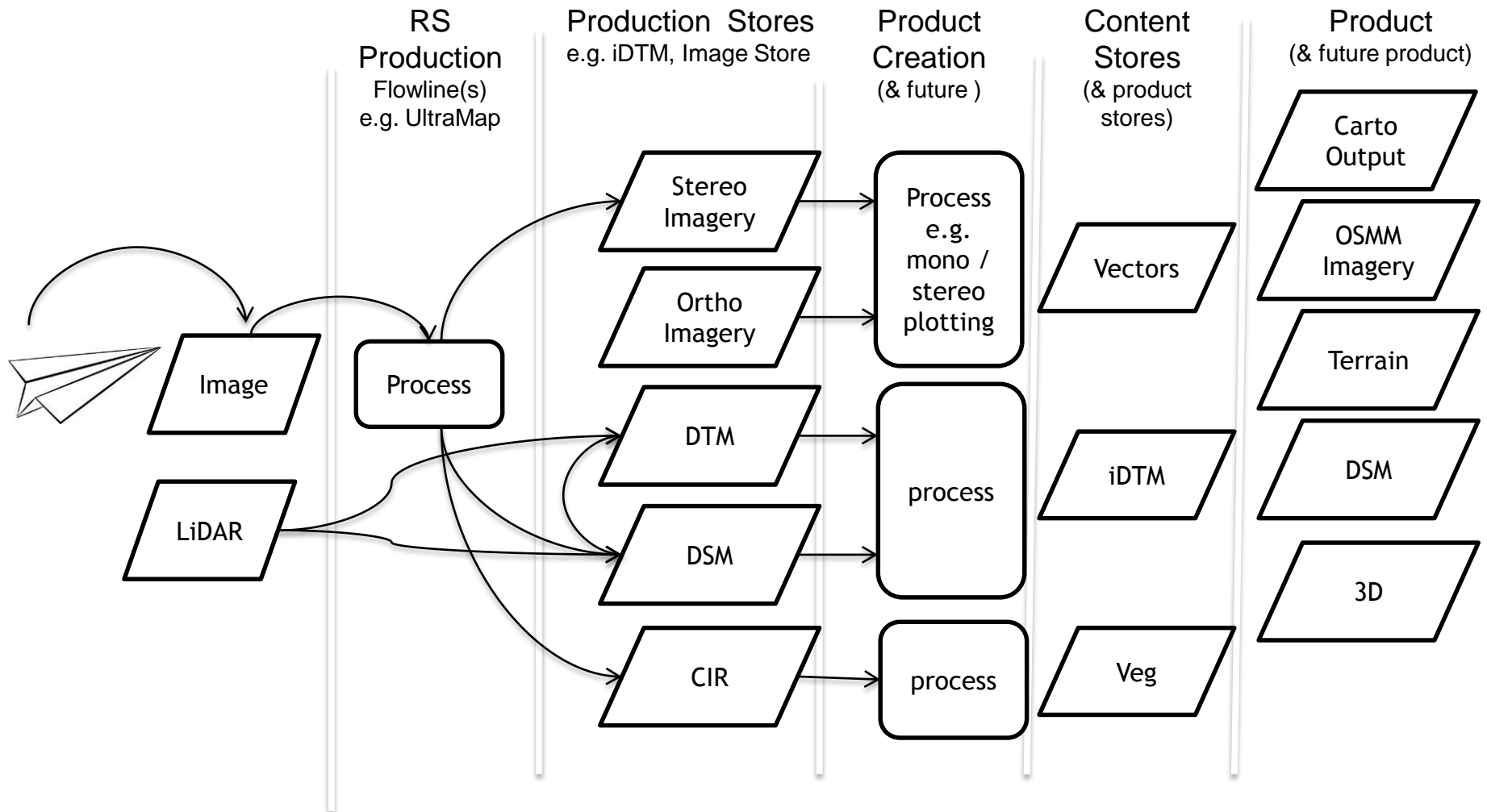
- Value Chain Analysis and Qualitative Benefits list from Stage 1
- Dublin Workshop in November (10 external delegates)
- Follow-up Interviews
  - Municipalities
    - Fingal County, States of Jersey
  - Private Sector
    - Developers
    - Real estate agents
    - Architects
    - Planners
  - Academia
    - Trinity College Dublin
    - City Dashboards Project (Maynooth University)
- Research of other initiatives
  - Helsinki, Gothenburg, London, Berlin

# Key Assumptions for Assessment

- National Digital Terrain Model from existing aerial imagery
- Photo textured LOD2 3D models available for all urban areas (as in green)
- Planning regulations will require digital 3D models for major schemes (as in Jersey)
- Models disseminated by:
  - Download with open license and requirement for models to be donated back to LA (The Jersey approach)
  - View - to public (free)
- Standard specification for interchange based on CityGML (OGC) standards.
- Not BIM model so does not include internal dimensions and services.



# Example Production Flowline

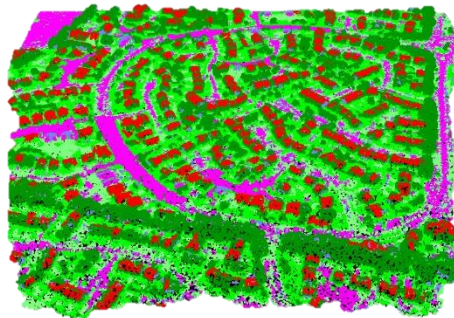


# Example Production Flowline

1. Colourised RGB point cloud from imagery



3. Classified point cloud



5. 3D buildings



2. DSM Height Field



4. Building classification



6. 'draped' imagery on 3D content



# Cost Comparison: Current Danish Tender

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- Country wide oblique aerial photography of approximately 43 000 km<sup>2</sup> captured in 5-10 cm resolution nadir.
- Period of image acquisition assessed to span from spring 2017 to autumn 2017 (maybe extended to spring 2018).
- Budgeted cost (excluding VAT): 30m DKK (€4.03m)
- Processing costs (Not available yet)
- Scaling:
  - Area of Denmark: 42925 Sq Km
  - Area of Ireland: 70273 Sq Km (scale factor 1.637)
  - Indicative cost for Ireland: €6.60m

# Benefits: Local Area Plan (LAP) Revision

- Cost savings for municipality
  - Number of 3D custom visuals required (estimated €8k per LAP)
  - 20% savings in staff time for preparation (€30k per LAP)
- Savings to citizens
  - Reduced submission costs
    - Easier to explain using visuals from chosen location, so less time required.
  - No reduction in number of submissions
    - Reductions from improved understanding, counterbalanced by wider engagement leading to more submissions (non-quantifiable benefit for improved local democracy)
- Software costs and training for municipality included
  - Based on Jersey experience



# Benefits: Major Scheme Planning Applications

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- Reduced costs to developers
  - No photo montages required
  - No physical models
  - But extra software and processing
  - Typical net benefit €12k per scheme
- Savings to citizens (as for LAP)
  - Reduced submission costs
    - Easier to explain using visuals from chosen location, so less time required.
  - No reduction in number of submissions
    - Reductions from improved understanding, counterbalanced by wider engagement leading to more submissions (non-quantifiable benefit for improved local democracy)

# Improved Public Sector Efficiency

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- Public sector savings of €82m per annum
  - Assessment of the Economic Value of the Geospatial Information Industry in Ireland (Indecon 2014\*)
- Conservative assumption that availability of 3D geo-information adds 2% to indirect public sector savings
- Value “written down” by 50% in order not to double count benefits from municipalities already included above
- Net impact: €820k per annum

# Scaling to National Impacts

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- Alternative statistical sources have been used depending on the nature of the benefit.
- Local Area Plan Revision:
  - Official Statistics\* for total urban area in Ireland (1640 Sq Km)
- Major scheme volumes:
  - Average planning application volumes over last 15 years
- Rates of change (for costing revision)
  - New address registrations from GeoDirectory (Irish national address database)

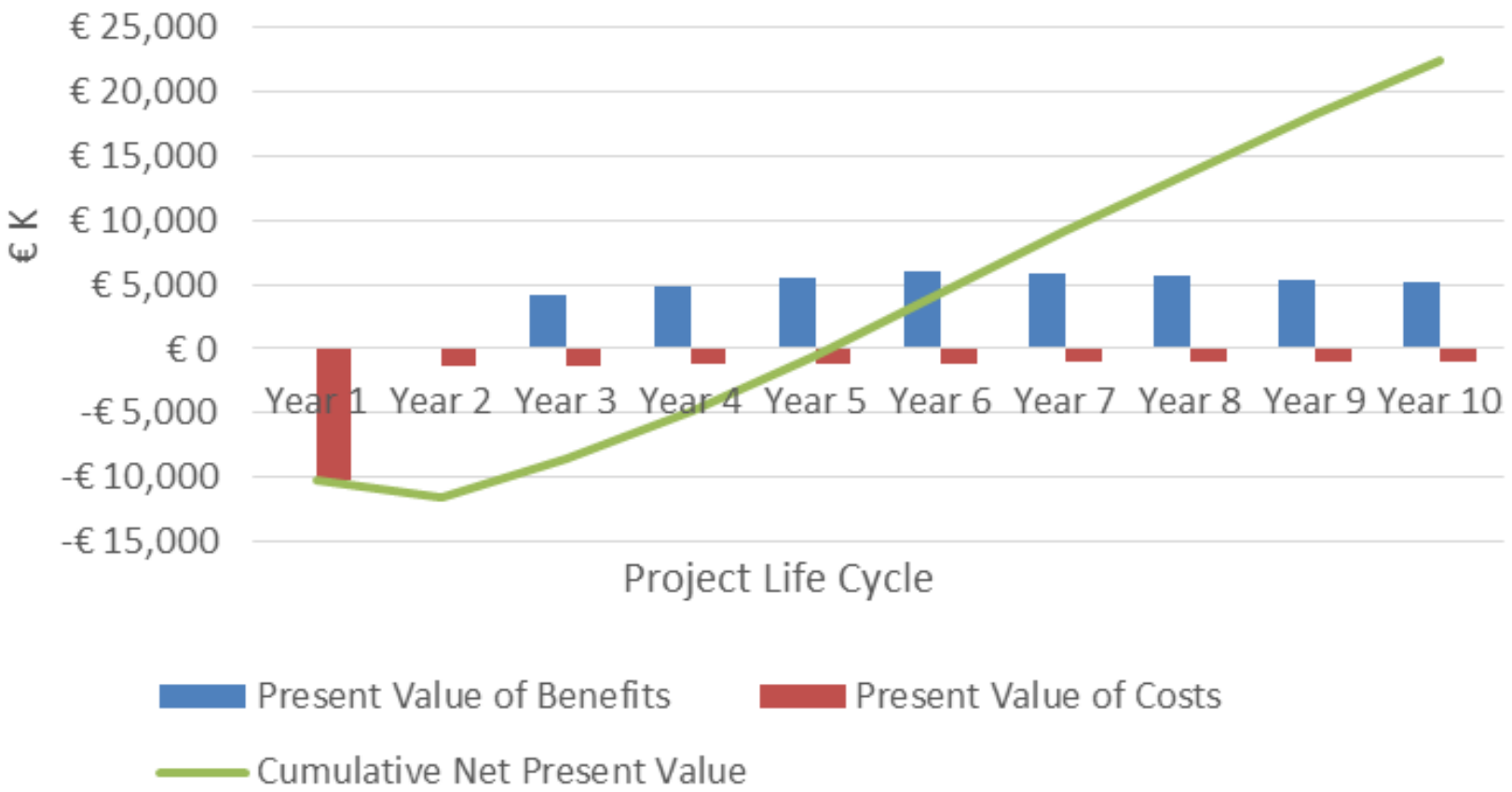
\*CSO

# Cost-Benefit Analysis (mean case)

Values in €1000s

Financial year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Year number	1	2	3	4	5	6	7	8	9	10
A. Net benefits to users	€ 0	€ 0	€ 4,562	€ 5,519	€ 6,476	€ 7,433	€ 7,433	€ 7,433	€ 7,433	€ 7,433
B. Revenue Stream	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0	€ 0
C. Cost to organisation	€ 10,211	€ 1,384	€ 1,384	€ 1,384	€ 1,384	€ 1,384	€ 1,384	€ 1,384	€ 1,384	€ 1,384
Net cash flow (A+B-C)	-€ 10,211	-€ 1,384	€ 3,178	€ 4,135	€ 5,092	€ 6,049	€ 6,049	€ 6,049	€ 6,049	€ 6,049
Discount factor	1.000	0.962	0.925	0.889	0.855	0.822	0.790	0.760	0.731	0.703
Present value of cash flow	-€ 10,211	-€ 1,331	€ 2,938	€ 3,676	€ 4,353	€ 4,972	€ 4,781	€ 4,597	€ 4,420	€ 4,250
Cumulative Net Present Value	-€ 10,211	-€ 11,542	-€ 8,604	-€ 4,928	-€ 575	€ 4,397	€ 9,178	€ 13,775	€ 18,195	€ 22,446
<b>Net present value (after 10 years)</b>	<b>€ 22,446</b>									
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Present value of benefits	€ 0	€ 0	€ 4,218	€ 4,907	€ 5,536	€ 6,110	€ 5,875	€ 5,649	€ 5,432	€ 5,223
Present value of costs	€ 10,211	€ 1,331	€ 1,280	€ 1,230	€ 1,183	€ 1,138	€ 1,094	€ 1,052	€ 1,011	€ 972
Sum of discounted benefits	€ 42,948									
Summ of discounted costs	€ 20,503									
<b>Benefit-Cost Ratio</b>	<b>2.1</b>									
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Net cash flow	-€ 10,211	-€ 1,384	€ 3,178	€ 4,135	€ 5,092	€ 6,049	€ 6,049	€ 6,049	€ 6,049	€ 6,049
<b>Internal Rate of Return (IRR)</b>	<b>29%</b>									

# Discounted Cash Flow



# Sensitivity Analysis

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- Largest variable likely to be Data acquisition Costs
  - Using Danish numbers illustrates a “worst case” scenario
  - Acquisition costs are thought likely to decrease over time
  - This would improve the return on investment
- Fingal estimates of savings maybe too high or low
  - Ideally we would have liked to validate more widely by a market survey
  - Suggested approach:
    - reduce benefits by 10% from mean to provide lower bound
    - Increase benefits by 10% from mean to provide upper bound
- Costs currently assume open data policy
  - No commercial pricing included or revenue
  - Model can be change to suit national policy

# Selected Qualitative Benefits

Actor	Process	Impact	Source
Local Authority (own housing stock)	Property Management	i) Desktop (virtual) inspections ii) Better targeted renovations	Dublin CBA Workshop
Solar panel vendors	Installing Solar panels	i) environmental costs reduces ii) new sales	Dublin CBA Workshop
GSI (Geological Survey Ireland)	Sharing between LA and GSI of borehole information	i) GSI build more granular 3D models and supply to LA, others ii) Reduced duplicated capture in local authority	Dublin Value Chain Workshop
Civil Aviation Authority	Obstacle identification	i) reduced costs of acquisition and make records comprehensive	Dublin Value Chain Workshop
Property Sales Agents	Better visualisation of developments	i) Easier sale ii) Less physical viewings	Knight Frank
Fire Service	Response to emergencies	i) Dispersion of smoke from fires and noxious chemicals in the case of escape. Buildings affect the plume propagation, both horizontally and vertically.	Dublin Fire Service
Software Companies	Standardising of data models	i) Allows companies to develop a software platform for one city but sell across Europe and wider because if the data is created using standards for data content, quality and transfer (interoperability)	Jarmo Suomisto, City Manager, Helsinki *
Local Authority / Environment Agency	More accurate noise mapping	i) Noise propagates in 3D, so the models are more accurate. ii) EU requirement for cities to create noise maps.	Klaus Nargle, Bentley Systems *

# Adapting for other geographies: Benefits Transfer

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- Benefits transfer is the standard economic technique for estimating benefits in geographies<sup>1</sup> where primary data (locally collected) is not available.
- Should be based on using authoritative official statistics from EuroStat\*, United Nations, World Bank, OECD or IMF
- Use appropriate multiplier to scale each quantified cost and benefit, for example:
  - For data acquisition costs                      Surface area
  - For staff savings                                      GDP per capita
  - For all others    GDP

# Example: GDP in 2015

Country	GDP (USD)	Multiplier
Belgium	407,420,117,393	1.55
Denmark	261,532,456,397	1.00
Finland	200,029,066,058	0.76
France	2,162,485,022,553	8.23
Ireland	262,642,002,880	1.00
Netherlands	674,157,332,051	2.57
Poland	423,206,260,777	1.61
Spain	1,083,048,071,992	4.12
Sweden	438,595,828,078	1.67
Switzerland	649,305,916,910	2.47
United Kingdom	2,545,520,599,608	9.69

