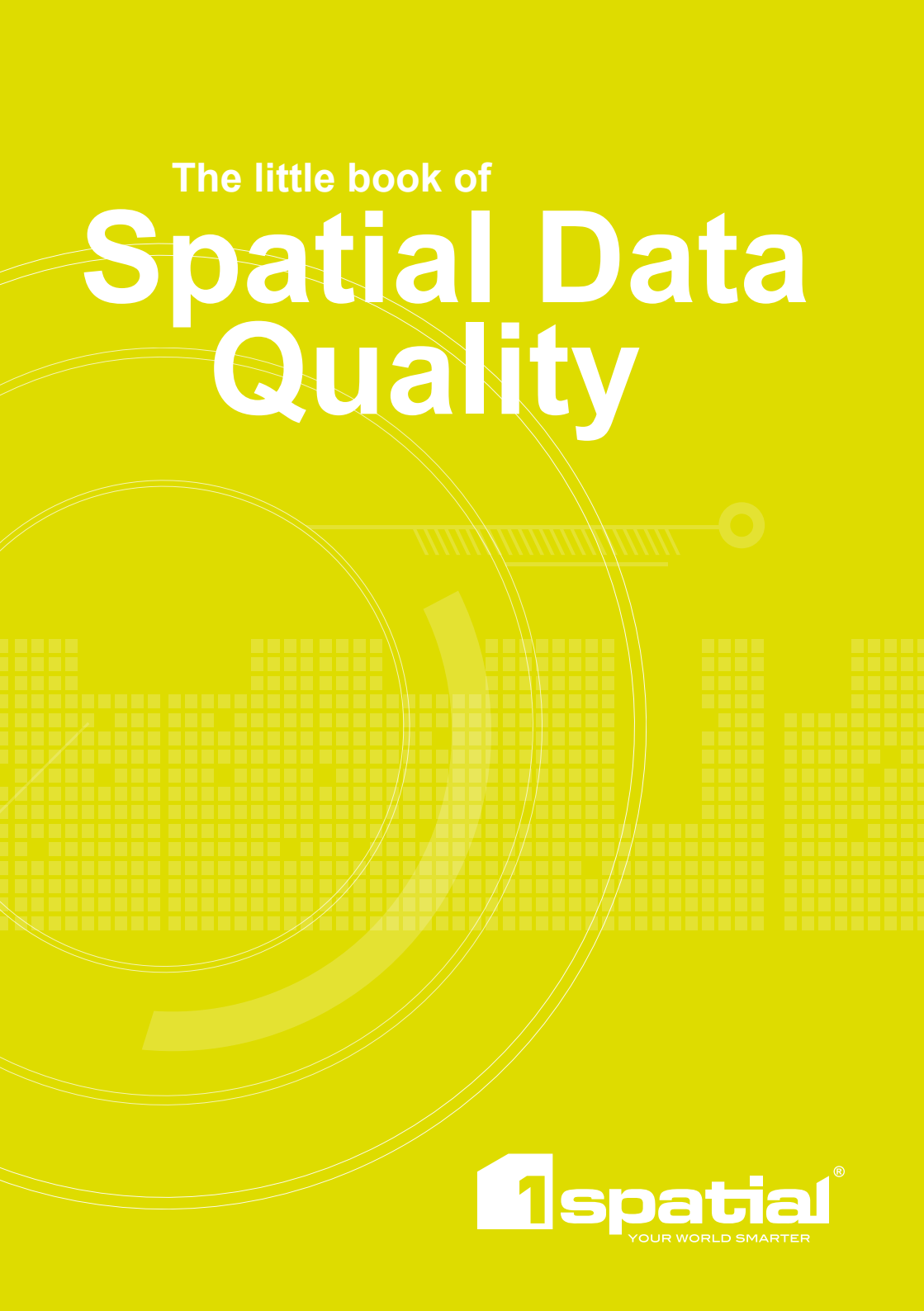
The little book of

Spatial Data Quality



1spatial®

YOUR WORLD SMARTER


$3.1
TRILLION
is how much IBM estimated that poor quality data costs the US economy each year

The importance of data quality

Geospatial data is increasingly central to decision-making in all walks of life. In fact, location-based data has the potential to generate $700 billion of value for the end user.[1]

However, not all data is fit for purpose and the cost of bad data can be huge. In recent research, IBM estimated that poor quality (across all types of data) costs the US economy $3.1 trillion each year.[2]

As spatial data is used and shared more widely, accuracy and reliability become of paramount importance. Just a few metres' error on a road layout can send vital emergency services many miles and precious minutes in the wrong direction. Misrepresenting the position of an electricity line can endanger the lives of workers and lead to power outages across a city. Operations relying on inadequate spatial data can waste large sums of money and damage their reputation for customer service.

Managing the quality of spatial data can seem a daunting task. Typically, an organisation's spatial data comes from different sources. They were collected over different periods, at different frequencies, to different levels of accuracy and for different purposes. Often, they are stored in different formats and at different levels of quality and completeness. Integrating that data to support a valid, single point decision is hard. Managing and maintaining that data for regular interrogation is even harder.

Instead of treating data quality as a series of discrete (and expensive) projects, more far-sighted organisations are taking a more holistic approach, with a data quality strategy that is aligned to organisational needs and requirements. They are adopting tools to automate data quality routines thereby reducing the cost and time involved in keeping their data continuously fit for purpose.

It's an approach that ensures their data is always available, up to date and accurate.

This little book discusses how an automated, rules-based approach to data quality is helping organisations build smarter data for smarter decisions.

The cost of poor data

The cost of poor quality data is enormous (as much as $3.1 trillion each year for the US economy[4]), but much of that is hidden.

The cost is not purely in the management of data, but also in the consequences of applying incorrect data. The real-world consequences of poor data can be large and sometimes catastrophic:

- Time wasted by users validating and correcting data themselves, often without feeding those corrections back
- The cost of lost revenue from misdirected sales, marketing and service efforts
- Resources wasted through acting on decisions built on bad data
- Lives put at risk through the inaccurate plotting of utility networks or the misrouting of emergency services.

New York City's Administration for Children's Services, like so many other large organisations, struggled with multiple sources of similar data in different formats and of differing quality. Analysts would draw on different sources and produce conflicting answers. The department estimated that only 20 per cent of analysts' time was spent analysing and reporting on the data – the other 80 per cent was spent searching for, validating and formatting data so it could be used.[5]

Australia's State of Victoria found that inaccurate spatial data was costing it millions of dollars each year. In one housing development alone, spatial information errors of up to 20 metres across the site resulted in costly delays and redesign works estimated to cost AUS$1 million.[6]

Underground utility networks. In the UK, research by Dr Nicole Metje of the University of Birmingham's School of Engineering[7] and Deputy Director of the UKCRIC National Buried Infrastructure Facility[8] reported on the cost and causes of buried utility networks being struck by construction workers. The research[9] included the following findings:

- In 52 per cent of incidents where plans had been reviewed in advance, the utilities did not appear on the plans
- In 84 per cent of cases where utilities had appeared on plans, they were inaccurately plotted.

Metje calculated the direct cost per strike as ranging from £300 (water) to £2,800 (fibre-optic). However, total true cost per strike (including the cost of disruption caused) is estimated to be 30 times the direct cost.[10]

Beyond that, of course, is the safety risk of a worker striking an underground electricity cable.

> Different parts of the business had semi-implemented their own GIS solutions, so we had half a dozen different systems knocking around. We needed to move to one central GIS and one version of the truth.
>
> **John Daniels,** Data Delivery Lead, United Utilities plc[3]

Incomplete and legacy data

Some sectors, like the water industry, suffer from poor quality legacy data. Often, these firms have inherited their base data from historic records created over a century ago or through company acquisitions. These records were often incomplete and inaccurate when created and have only deteriorated since then.

On top of that, where government regulation has passed additional responsibilities to privatised utility firms, the additional estate comes with records that risk polluting, or at least diluting, any data quality work that has been completed on the firms' existing data.

Poor records damage customer service by making it harder to locate the source of problems.

Poor data also makes effective asset management difficult to achieve. Preventative maintenance and investment plans are handicapped by lack of knowledge as to the location and nature of the assets in question.

Departmental siloes

Many organisations already have a wealth of geospatial data sitting, untapped, within their offices, but it is often locked in departmental siloes.

Sometimes, the firm spent a large amount collecting data for a critical decision; but the data was collected in isolation and today sits decaying in a zip file or a database, inconsistent with other corporate data, often duplicated but of uncertain quality.

Multiple data sources

Some organisations rely on constant updates of information from other sources. Examples include state Departments of Transport (DoT) in America, where each state must aggregate road information from county-level inputs and then add additional data like traffic density data or information on speed limits. Arizona DoT, for instance, combines data from 15 counties and 17 public-safety answering points.

Agencies like the US Census Bureau have a similar challenge, as do defence departments like No.1 AIDU, part of the UK's Joint Forces Intelligence Group. AIDU is responsible for providing maps, charts and aeronautical data to defence aircrew, air traffic controllers and aerospace battle managers of UK and allied military forces.

Where land management agencies must constantly validate field and land boundaries, or where agencies use automated processes, the input data must be consistent and valid.

For agencies like these, it is a constant challenge to ensure that new data enhances rather than pollutes existing master data.

This can only be achieved by treating data quality as an ongoing process.

Realising the spatial data opportunity

The volume and range of spatial data available to organisations will continue to grow dramatically as the Internet of Things evolves. More and more sources (employees, customers, stock items and assets) will produce increasing amounts of location data.

The accuracy of available data will improve massively, as well. The advances we've seen in, say, Google Maps over the last five years are nothing compared to what we'll see in the next five. Consumers and businesses will soon have levels of accuracy in real-time that were previously the preserve of national mapping agencies, whose data was tied to relatively slow and fixed release schedules.

Data is one thing, however; insight is quite another.

Insight comes from combining and interrogating reliable and authoritative data.

Data is only useful if it is sufficiently accurate for its intended purpose. It is only accurate if it is managed, and data management can be costly.

Where data quality is poor, decision-making becomes slow and error-prone. Potential insights become uncertain.

As data from different places is combined, its value can decrease instead of increase. Poor quality data leads to wasted effort (and can even destroy otherwise sound initiatives).

The value of location-driven insight is only revealed once you have established a firm and fixed set of data that you can trust, depend and rely on.

Once realised however, the potential value is enormous.

According to business consultants McKinsey & Company, location-based data has the potential to generate over $100 billion of revenue for service providers and up to $700 billion of value to end users.[11] However, in its December 2016 report, McKinsey estimated that only 50-60 per cent of this potential was currently being captured.

McKinsey also noted the emergence of new opportunities:

> "Today there are new and growing opportunities for businesses in any industry to use geospatial data to track assets, teams, and customers in dispersed locations in order to generate new insights and improve efficiency."[12]

Analyst firm Gartner estimates there were 6.4 billion "things" making up the Internet of Things (IoT) in 2016, up 30 per cent from 2015.[13] The firm also predicts that IoT will save consumers and businesses $1 trillion a year in maintenance, services and consumables by 2022.[14]

In research for Google, Oxera estimated that "geo services" saved 1.1 billion hours of travel time and 3.5 billion litres of gasoline each year. The report calculated that improvements to agriculture yielded global savings $8-$22 billion and the globally added value from geo services was $100 billion per year.[15]

Ordnance Survey's authoritative reference dataset is independently valued at £100 billion.[16]

The value of geospatial data as a corporate asset is clear but, even if the value is unquestionable, the cost can seem unaffordable. Managing data from multiple, disparate sources is complex and sounds both time-consuming and expensive.

Cleansing data for a single, point decision is a major project. Maintaining it for ongoing interrogation can seem impossible.

However, as businesses appreciate the strategic value of geospatial data, its importance rises through the organisation. In today's leading organisations, data is a boardroom priority, with geospatial playing a significant part in the data mix.

Yet, for geospatial data to deliver on its promise, it must be made cost-effectively reliable.

> "No longer is [geospatial] information just a back-drop map, it is actually a fundamental part of our users' business solutions."
>
> **Colin Bray,** Chief Executive, Ordnance Survey Ireland

Managing data quality

Make your data fit for purpose

To be cost-effectively reliable, spatial data must be kept fit for purpose.

To achieve this though, you must first be clear about what “fit for purpose” means in your specific context.

At 1Spatial, our approach is to help you discover and precisely define your data quality requirements, to check how your data conforms to those requirements, and then to cost-effectively bring your data up to standard.

What do we mean by data quality?

No data is a perfect reflection of the real world, so organisations typically decide what level of quality is acceptable. This could mean defining which rules are mandatory or optional and the acceptable conformance levels for each rule.

The key is understanding what you need, and we often help clients to determine their exact business requirements to allow them to define quantitative quality metrics.

Understanding data quality begins with understanding what is required of the data to hand. What is the required level of quality? Where are there potential gaps? And, how can these be filled to a required level?

There are two essential reference points:

- Where you need to be (the desired state of your data)
- Where you are (the current state of your data).

Only when those two points are known, can data quality be effectively managed.

Where you need to be

Understanding the desired destination is critical to achieving any level of data excellence. What will your data be used for? What level of quality is necessary to fulfil that purpose? What might be fit for one purpose may be inadequate for another.

Nor is choosing “perfection” the easy option. There are costs associated with over-engineering data quality.

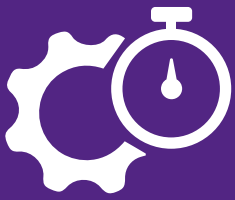
Achieving data excellence means maintaining your data at the level of quality required to do its job.

Decisions taken at the early stages are critical. It is vital to have a clear view of quality requirements. Poor quality data can be dangerous, but over-engineering can be costly. Successful projects take a view on immediate and foreseeable uses of the data.

It can be useful to consider data quality from a utility perspective: what is the use derived from having data at a particular quality (compared to the cost of getting to that level). This can be considered under the following headings:

Financial

Increased costs or delays caused by poor data, opportunities missed or penalties incurred.



Productivity

Increased workload and decreased productivity, delays, poor end product etc.

Confidence

The impact of poor data on customers, suppliers, employees and other stakeholders; confidence in decisions or forecasts based on poor data; loss of trust in products (for example, maps) built on poor data.

Risk and compliance

The risk of fines and other penalties for failing to comply with regulations, or to meet regulators' requirements, increased investment risk or poorer competitive insight.

Spatial data is particularly sensitive to variations in accuracy and completeness along the following dimensions: positional, topological, temporal and thematic.

Where you are starting from

How good, or bad, is your current data? Surprisingly few organisations have a good understanding of the current state of their geospatial data. When the OGC (Open Geospatial Consortium) conducted a survey some years ago, only 57.5 per cent of respondents felt that their data was fit for purpose.[17]

In the same survey, 39.6 per cent of responding organisations were not involved in any spatial data quality projects. Only 42.5 per cent felt they had the means to quantitatively measure the quality of their spatial data.

Of course, the question of data quality can only be answered in the context of its intended purpose.

A process for data improvement

At 1Spatial, we use the following quick process to discover the current state of your data. We want to help you understand whether it is really a set of data that you can trust.

The process starts with a data discovery workshop, to gain an initial understanding of your data, its structure and the scale of work required. We ask a few people with knowledge of the data and its use to join the workshop. We then agree on the most important elements of the data to focus on.

Data discovery tells us whether there is a data quality problem. We then explore how this impacts your business, and agree if there is a need to make improvements. If we do, then we often move onto the next steps in the process:

1. Data Improvement Requirements Workshop
2. Sprint
3. Retrospective.

Workshops, which normally take place on your premises, bring together key people in your business. These sessions define packages of work or tasks to explore data further, to resolve quality issues, prioritise them and create a Backlog of work.

Backlog tasks are then assigned to a Sprint, each of which normally lasts for one or two weeks.

During each Sprint, we work through the assigned tasks, test outcomes and make measurable improvements.

When we have made the required changes and tested the results, we present these back to everyone in a Retrospective. Through the Retrospective, we learn from our experiences and agree actions to make sure we continuously improve for the next iteration.

At this stage, we also start to prioritise the work for the next Sprint which, including feedback from stakeholders, forms the basis of the next Sprint.

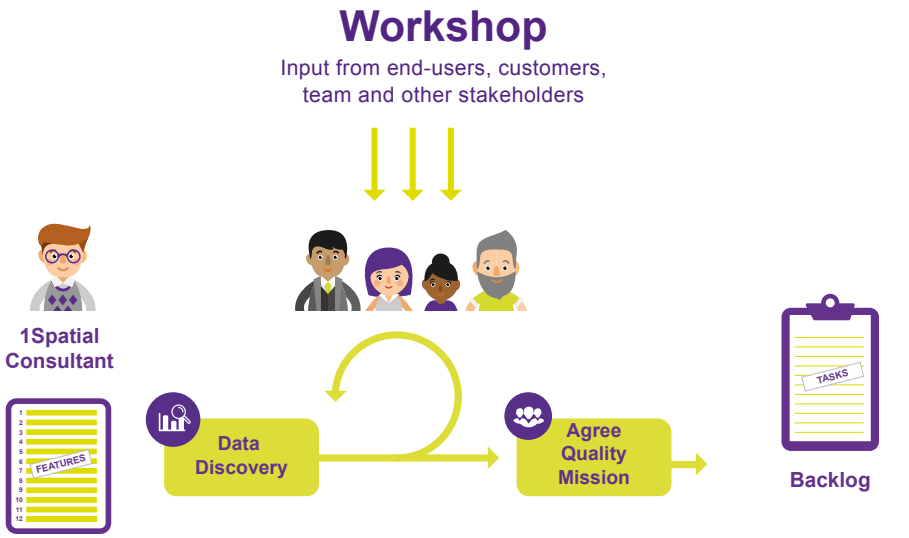
Each Sprint usually results in a further improvement in output data quality.

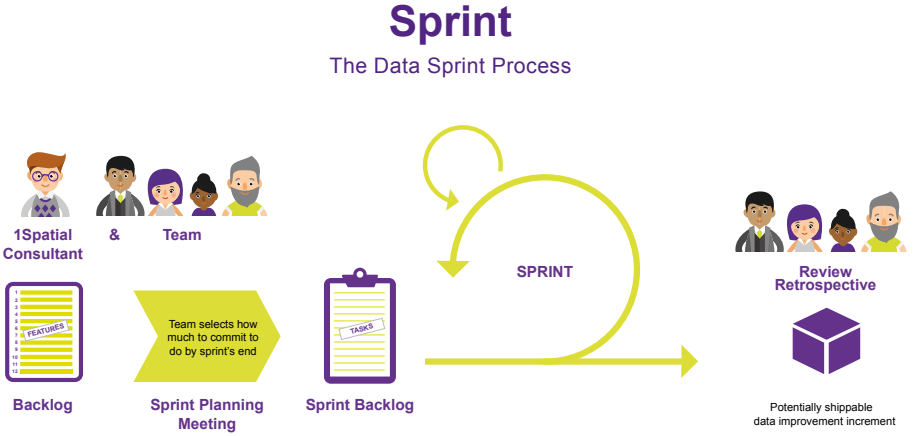
The entire process is a collaborative effort between experts in your team and ours.

We follow methodologies for agile data consultancy which have evolved through our experiences of many similar, data-driven

projects. These enable collaboration and provide feedback as quickly as possible while eliminating wasted time.

We have become experts at helping our clients define and drive their Data Strategy. We help you define data quality goals, then audit and assess current quality against those. Using our data-management tools, we can then apply advanced algorithms and predictive techniques to improve data quality and reach those goals.





Six data excellence principles.

01. Embrace
automation.

02. Ensure
repeatability and traceability.

03. Design
simple solutions to difficult scenarios and avoid unnecessary technical complexity.

04. Target
the typical, not the exceptional, in order to maximise value.

05. Adopt
an evidence-based decision-making process to create business confidence in the outcome.

06. Collaborate
to identify issues and work towards a solution.

Data quality tools

Organisations with large geospatial databases, deploy a variety of tools that use rules-based automation, to maintain data quality to required standards in a cost-effective and time-efficient way. These rules-based tools allow for sub-sets of geospatial data to be extracted, updated, validated and then returned to the database without affecting the usability of the core data.

These types of systems are perfect for running fast iterations, to test out ideas and hypotheses, so the teams can quickly find out which problems really need to be solved. Such systems ensure that data maintenance can be carried out in a timely and cost-effective manner, so that the master dataset is always as accurate and reliable as possible for all users.

To be most effective, it is important that such tools interoperate seamlessly with other GIS and geospatial systems that the organisation may use, such as Esri's ArcGIS.

At 1Spatial, we are committed to supporting open standards in geospatial data and we strive to work seamlessly with all leading GIS systems.

We also partner with the leading technology vendors in the field, including: Esri, Oracle, HERE, SAP, Safe Software and Latitude Geographics.

Data Excellence Principles

Driving data quality can be expensive and time-consuming, especially without a clearly determined goal. Too many initiatives are planned and run as one-off exercises. Many run aground by targeting the most difficult problems, rather than considering where the return will be largest.

We find that successful projects are run in accordance with six data excellence principles.

1. Embrace automation
2. Ensure repeatability and traceability
3. Design simple solutions to difficult scenarios and avoid unnecessary technical complexity
4. Target the typical, not the exceptional, in order to maximise value
5. Adopt an evidence-based decision-making process to create business confidence in the outcome
6. Collaborate to identify issues and work towards a solution.

Data stewardship

Data quality cannot be a one-off exercise. In fact, data becomes more valuable, and the return on investment higher, when a data set is maintained for ongoing interrogation.

The companies that are most successful in leveraging their geospatial data have a clearly articulated data strategy and recognise the importance of data stewardship; the management and maintenance of defined data-sets to an agreed level of quality for a recognised purpose.

Data stewardship uses approaches like the Data Improvement Process and Data Excellence Principles, to cost-effectively manage data-sets. It defines required levels of quality and then uses robust processes to ensure that any issues are resolved at source, so that errors do not simply re-occur at the next data refresh.

Data stewardship addresses issues of data ownership and standards definition. The data steward also selects tools that interoperate seamlessly, reducing any scope for manual error or extra work in moving from system to system.

Aspects of data quality

Generally, we see organisations considering data quality in three stages:

- Data validation
- Data cleansing
- Data enrichment.

Data validation

Data validation – checking that your data holding and all incoming data complies with required standards – can be a headache. How do you keep your data current without regular updates? How do you validate your updated data? And, how do you continually keep core data both reliable and accessible?

Our automated, rules-based approach validates data at the point of collection, in the field on a mobile device, or before it is accepted into your database.

It prevents bad data polluting the information required for good decisions.

Trust your data

As organisations increasingly rely on spatial data, they often access it in real time to drive decisions from delivery routes to major investment projects.

When your organisation relies on reliable data, you need a system that cost-effectively and quickly ensures that the data entering your database conforms with your requirements. Is it accurate, consistent, correct, current and complete?

The 1Spatial approach allows the user to define and manage rules against which all data is tested. These rules are held in a single, central, technology-neutral repository and can be run against new data on demand. These rules can also be shared between systems, people and organisations.

They can run in the background as a surveyor collects new data on the ground, flagging when new entries don't conform with the requirement. This enables the data to be checked there and then, reducing the need for costly re-visits.

The rules can also run on batches of data as they are submitted – but before they are added to your core data.

Data can even be fixed automatically, on the fly, based on the same rules so that good data is quickly integrated, and exceptions flagged for manual review.

Our enterprise-wide, cross-platform automation quickly and cost-effectively protects your core data asset, helping to make your data smarter.

“By using 1Spatial Cloud, we were able to save at least a quarter of the time on the quality control aspect of the project. This was mainly because of its flexibility, ease of use and speed of getting the team up and running and the fact that the service was always available online.”

Jimena Martinez, Project Manager, Sinfogeo

Example: Sinfogeo

When GIS consultancy Sinfogeo won the contract to produce a new map series for the whole of Spain, it had to consolidate, validate, cleanse and harmonise data collected by both the Spanish Government and the Army.

One of the biggest challenges was to ensure the quality and accuracy of data throughout the project. With data being submitted from across the country, this would have been a time-consuming and costly project.

However, Sinfogeo used the 1Spatial Cloud platform to automate the process of validating and cleansing the data, using a rules-based approach. As Sinfogeo's Project Manager, Jimena Martinez explains:

"We knew what we needed a rule to do, but we didn't know how to write it. Working with the team at 1Spatial was great, and together we quickly created and tested all the rules that the Government and Army needed. This meant we didn't need to employ and pay staff on our side, or develop many new things on our own."

Once the validation rules were finalised, they were simply loaded into the cloud service ready for all contributors to access.

By utilising exactly the same set of rules, Sinfogeo could be sure that all data submitted would be quality controlled and matched to the same standard. Contributors simply submitted their data to a single service and would receive a validation report back in a matter of minutes. The report would give them an overall view of the data quality but would also enable them to pinpoint the exact location of any data errors so that they could quickly and easily complete fix up of the data prior to finally submitting it to Sinfogeo as complete.[18]

Example: Arizona Department of Transport

In the US, each state's Department of Transport has become responsible for aggregating highways data held independently at a county level and reporting that to the Federal Highway Administration. Typically, county-level information is held in a variety of different systems, at differing levels of accuracy and is of different ages. As a result, consolidating and validating this data has been a costly and time-consuming project.

The Arizona Department of Transport has purchased 1Spatial's 1Integrate product to validate its state-wide road network. The Department will now validate and integrate its own road network information, with regular updates from multiple contributing government bodies within the state.

1Spatial's 1Integrate technology will enable the Department of Transport in Arizona, to automatically quality assure the information it receives from the combination of 15 counties and 17 public-safety answering points (PSAPs), by validating it against a set of pre-defined business rules. They will also be able to match new data submissions against the current version of the road network, to identify changes in geometry and other attributes and apply these changes. This new process will save them a significant amount of time and money.

Data cleansing

Understanding the condition of your data is important, but fixing it is vital if you need to make improvements. Poor data quality can mean bad business decisions and requires a time-consuming, expensive, and often manual, project to put it right.

At 1Spatial, our technology not only reports the current condition of your data, it can repair it too. Even better, we can set up a process of continuous, automated improvement that gets your data clean, then keeps it clean.

Automate complex, time-consuming and previously manual processes

We work with you to establish the quality level you require for your data to be fit for purpose. We then help you develop user-defined and user-managed data quality rules that will find and fix quality issues.

Once created, these rules will run against your data repairing all the common errors and flagging the difficult exceptions for manual correction.

The rules – held in a single central repository – then become an automated, repeatable process that can clean and correct newly acquired data to prevent bad data polluting your dataset. The quality levels can be recorded over time, to provide important metrics to enable measurements for continuous improvement.

With a shorter time to usable data, and a faster route to user-trust, 1Spatial technology makes your data both cleaner and smarter.

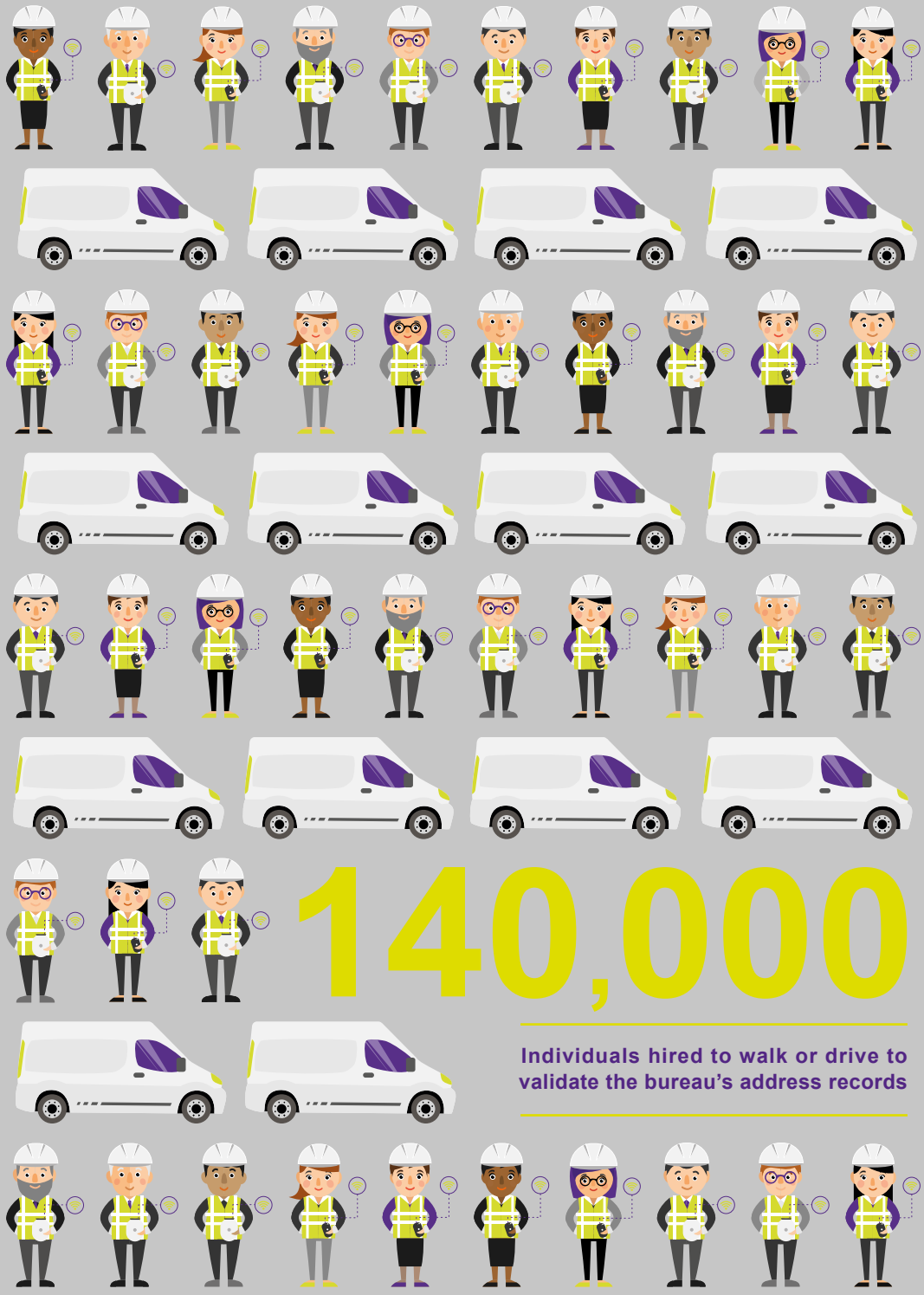
Example: US Census Bureau

Conducted every 10 years, the US Census is the largest civilian activity in America. It counts and profiles a population of over 318 million and involves checking 135 million addresses. The result is used to correctly apportion political representation, and to allocate federal funds worth $400 billion each year.

To create the geographic platform for each census, the bureau aggregates data from 3,200 counties and other organisations. Identifying changes, integrating new data and maintaining the correct relationships between all of these data-sets, is a critical challenge for the census bureau.

"Integrating the data was a very manual process," explains Tim Trainor, Geography Division Chief at US Census Bureau. "It took a very long time to deal with that level of data."

For the 2010 census, the bureau hired 140,000 individuals to walk or drive every street in the country and validate the bureau's address records.



140,000

Individuals hired to walk or drive to validate the bureau's address records

25%

of 2010's 140,000 field canvassers will be required by 2020

After the census date, the bureau also required over 600,000 people to trace non-respondents, or identify addresses as vacant. The total cost of the 2010 US Census was $12 billion. On the same basis, the forecast for 2020 was $17 billion.

1Spatial worked with the bureau to automate their data management process, based on user-defined, user-managed rules. An automatic data conflation process now manages the acceptance and integration of data submissions from the bureau's 3,200 partners.

This high degree of automation means the bureau can process more partner files, more quickly, making the bureau's database more accurate and up-to-date.

As a result, the 2020 US Census will require much less field canvassing. Trainor estimates that only 25 per cent of 2010's 140,000 field canvassers will be required. The ability to integrate data from other agencies, like the US Postal Service, also reduces cost.

"We estimate that the cost avoidance will be a little over $5 billion." says Trainor. "That's close to the cost of the 2010 census, and quite an achievement."[19]

> We estimate that the cost avoidance from these four innovation areas will be a little over $5 billion.
>
> **Tim Trainor,** Geography Division Chief, US Census Bureau

> The cost difference is quite significant. Our original plan was to physically map just one third of the transferred network within our current, five-year asset-management period. That would have cost £10 million. Working with 1Spatial, we're able to deliver a map of the whole transferred network in just two years, for £1.25 million.
>
> **Mike Madine,** Head of Wastewater Networks and Developer Services, Northumbrian Water Group

Data enrichment

Data enrichment releases greater value from existing data investments, by combining the best parts of different data-sets to create something new. You can also use third party and public data to augment core information, giving you a faster route to reliable, trustworthy data.

Is your data fit for purpose?

Keeping your data fit for purpose can be an ongoing challenge: business requirements evolve, data standards change and of course, data decays over time.

A strategy of data enrichment, ensures you make best use of your existing data assets, to make your core spatial data current and accurate.

Perhaps the customer addresses in your billing system are the most accurate in your organisation, but your asset database has the best view of your network. Taking an automated, rules-based approach, you can combine the best of both data-sets, even if the data exists in different formats, within different systems, in different data siloes. You can then fill any gaps with data you purchased from a third-party provider.

Our solutions help reduce your "time to value", helping you to achieve and maintain usable, trustworthy data with minimum time and cost.

Example: Northumbrian Water

Northumbrian Water (NWL) assumed responsibility for an estimated 13,500 km of private drains and sewers when the law changed to transfer ownership from property owners to local water companies. However, only 5 per cent of the inherited network was mapped.

NWL's original plan was to manually survey one third of the estate in its current AMP planning period. Learnings from this first period would then be applied to the remaining, unmapped network. However, the project to map one third of the network was estimated to cost £10 million and take five years.

The firm needed a faster, more cost-effective solution.

1Spatial proposed an approach built on its 1Integrate solution. We worked with subject-matter experts at NWL to develop a series of rules, to infer the missing information, based on limited records available and the expertise of NWL's staff.

This innovative, iterative approach cost just £1.25 million to map the entire network – a saving of £8.75 million (87 per cent) against the first five-year budget alone – and would be complete in two years, one eighth of the originally planned time.

As a result, NWL more quickly acquired the information it needs to provide its excellent customer service and to build more effective maintenance and investment programmes.[20]

The 1Spatial Approach

1Spatial is a software solutions provider and global leader in managing geospatial data.

We work with our clients to deliver real value by making data current, complete and consistent through the use of automated processes - ensuring that decisions are always based on the highest quality information available.

Our unique, rules-based approach delivers enterprise-scale, cross-platform, automation to all stages of the data lifecycle. It builds confidence in the data while reducing the time and cost of data management.

We build long term partnerships with our clients and deliver real value to them through solutions that are grounded in a deep understanding of their needs and challenges.

Our global clients include utility and telecommunications businesses, national mapping and land management agencies, government departments, emergency services, defence, census bureaus and transportation organisations.

A leader in our field, we have a wealth of experience and a record of continual innovation and development.

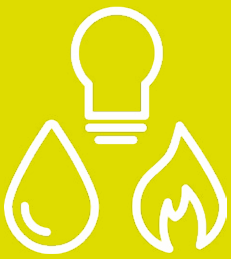
We partner with some of the leading technology vendors including, Esri, Oracle, SAP, Safe Software and Latitude Geographics.

Today, with an ever-increasing reliance on geospatial and location-critical data, demand for our expertise has never been greater.

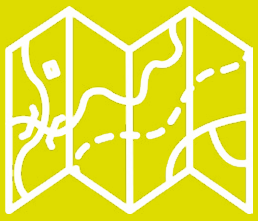
Our goal is simply to make your data smarter.

To learn more about how 1Spatial can help make your data smarter, visit www.1spatial.com.

Engineering



Utilities

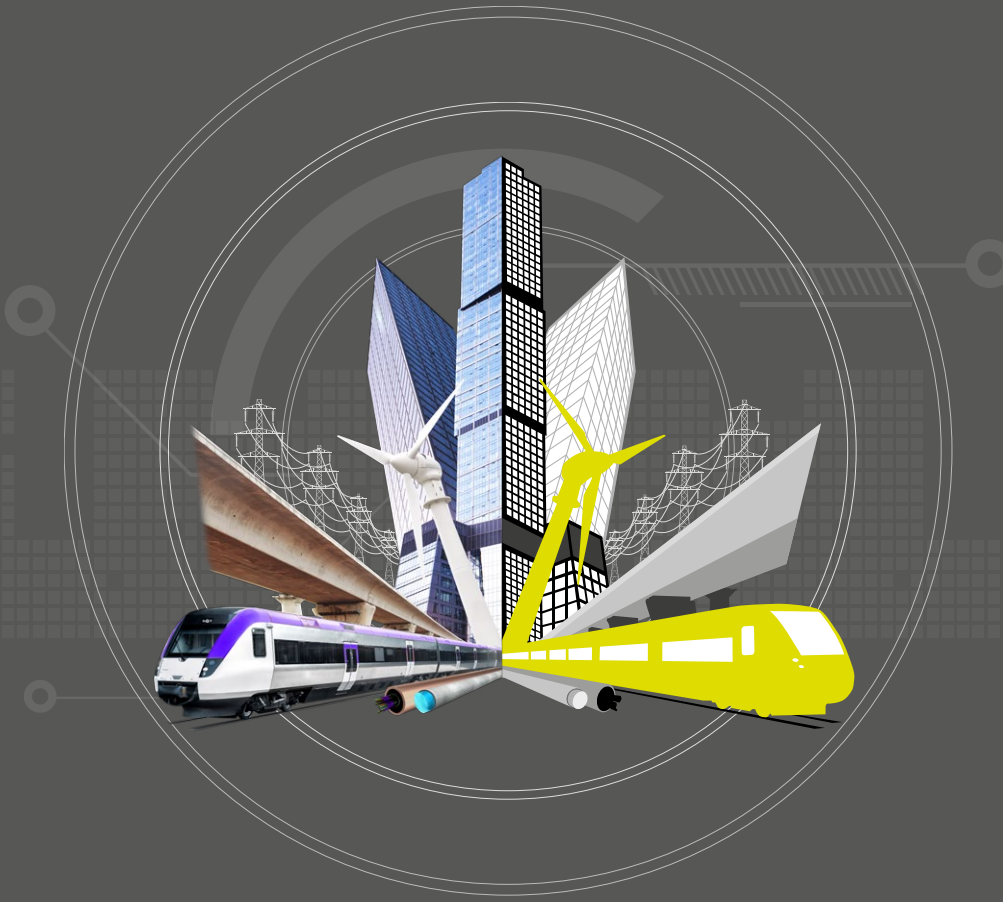


National Mapping Agencies

Transportation and Infrastructure

Land Management

Government



Conclusion

Smarter data, smarter world.

Geospatial data is increasingly central to decision-making for both business and the consumer. As the old industry adage says, everything happens somewhere and location data is often the only common point linking disparate sets of data.

The global added value from spatial data is estimated at $100 billion per year and, as this value is more widely recognised, data's importance rises through the organisation. In today's leading organisations, geospatial data is a boardroom priority.

However, the potential value of spatial data is wholly dependent on its quality; the cost and consequence of poor data quality can be large and sometimes catastrophic: wasted time, lost revenue, poor decisions and lives at risk.

Ensuring data quality is critical and organisations are beginning to treat this as an ongoing process, rather than a discrete project. They are deploying solutions that automate their data quality and data management procedures, to benefit from:

- Dramatically reduced cost of quality
- Much faster time to value
- In-house experts freed up to drive value and innovation
- Reduction in manual errors.

1Spatial has a wealth of experience working with the largest geospatial databases in the world. Our unique, rules-based approach delivers enterprise-scale, cross-platform, automation to all stages of the data lifecycle. It builds confidence in the data while reducing the time and cost of management.

We help land management and national mapping agencies, transportation organisations, utility companies, defence departments and the governments of countries, regions and cities to collect, store, manage and interpret location-specific information. Our open approach to data excellence ensures that our tools, processes and the data we manage work seamlessly with other leading players in the geospatial sector.

To learn more about how we could help you develop smarter data for a smarter world, visit www.1spatial.com.

End notes

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[2]IBM, Extracting business value from the 4 V's of big data (2016), **http://www.ibmbigdatahub.com/infographic/extracting-business-value-4-vs-big-data**

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[17]Open Geospatial Consortium Data Quality Working Group, Geospatial Data Quality Survey (2008). A survey of 750 responses from organisations of all sizes across 107 countries. Q14: Is the data in your organisation used by your end customers for its intended purpose?

[18]Please see the Sinfogeo case study at **https://1spatial.com/customers/sinfogeo/**

[19]Please see the US Census Bureau case study at **https://1spatial.com/customers/u-s-census-bureau/**

[20]Please see the Northumbrian Water case study at **https://1spatial.com/customers/northumbrian-water/**

1spatial.com/capabilities/data-quality