Survey4BIM

Survey4BIM is a cross-industry group open to all organisations involved in the survey, collection, management, processing and delivery of geospatial information within the context of building information modelling (BIM).

The group involves clients, contractors, consultants, suppliers, subcontractors, institutions, academia and other bodies — reflecting the composition of the construction sector in which it operates.

Survey4BIM’s mission is to provide a forum for survey organisations and industry professionals to collaborate and share their journeys putting BIM into practice, and to provide best practice guidance documents on survey matters relating to BIM.
Introduction

Location is known as the fourth decision driver when it comes to major construction projects, behind cost, time and complexity. In many ways location is taken for granted; the positioning of structures on the land beneath our feet is the one concrete aspect we can see with our own eyes amidst the uncertainty of ever-changing project budgets, timescales and designs. However, for location to truly drive a project, you need precision. For precision, you need geospatial technology — and the professional surveyor who knows how to implement it.

The need for ongoing reliable and accurate spatial data is critical. The consequences of getting the position wrong at any stage of a construction project can impact the programme and cost. At handover to the client, the ability to navigate easily and quickly around the facility will pay back in spades through its lifespan.

Building information modelling (BIM) is gradually changing the way the UK and global construction sectors operate. It is bringing together technology and new practices of collaboration to manage the complexity of projects within time and budget constraints. But BIM is only as good as the professionals feeding the model. We cannot forget that however all-encompassing BIM is, all construction sites sit on the land and that brings topographical and positional challenges. The geospatial data that feeds geographical information systems and computer aided design is still necessary — even more so now it will factor into the information model that will see buildings and major infrastructure through from conception to demolition.

The surveyor not only has the specific geospatial skills and awareness of the BIM process to ensure that successful implementation of coordinates on site can be managed throughout this lifecycle, but is also a key player in the successful management of a construction project. The surveyor is there to advise, to direct and guide the client through the fast-changing technology that will give the precision to build where you need to build, to meet where you need to meet and, just as importantly, to avoid what you need to avoid.

This guide highlights the key elements where a surveyor’s expertise can make the difference. It is not intended to be a definitive guide to BIM or surveying. It aims to give clients and survey practitioners alike a pragmatic understanding of the sequential development process, highlighting the issues for both to consider.

The Survey4BIM team hopes that the reader will finish this guide with a better sense of the key role that professional surveyors can play in the wider BIM process.

Ian Bush, Chair, Survey4BIM
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About this Guide

This guide has been produced to answer the question; how does survey fit into the BIM process? It is the result of many discussions of the Survey4BIM working committee and incorporates input from professionals in all aspects of the survey industry.

The best way to appreciate how survey fits in with the BIM process is to look at the complete lifecycle of a project from conception, to handover, to operation, through to possible demolition. At all stages of this cycle there is a requirement for survey information that is fit for purpose.

In practice, many survey professionals are entering the BIM process halfway through the cycle. This guide is designed in such a way that the user can pick up and understand both the client and practitioner requirements and expectations from geospatial data at any stage of the project lifecycle.

By definition, it is assumed that the users of this guide are already familiar with the concept of BIM and its implementation in the construction environment. If not, then the reader is directed to the links on page 13 which provide an excellent reference to the application of the UK government’s BIM programme.

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Stage 0: Strategy

Aim
This is the time to identify the client’s business case, strategic brief and other core project requirements. The surveyor will define the coordination scheme with a full overview of the project.

Typical scenario
In the early stages of a project, broad-based survey data and information are used to give background to the project. At this stage it is most important for survey practitioners to advise on the type of geospatial information that will be available to stakeholders and identify where coordination or mis-coordination can occur.

Questions the client needs to ask
• What stage is the project at now?
• What data is required to move forward in the decision making process?
• How could, and should, this change in the future?
• What problems and issues do I have, what are their symptoms and are they part of a wider problem?
• What data do I have already?
• Does my existing data support my needs and requirements?
• What gaps are in my data?

Risks the client needs to be aware of
• Lack of understanding of available, and possible, data and their implications.
• Lack of reliable data on which to make decisions.
• Lack of available and reliable professional consultation.
• Unwillingness to pay for professional consultation.

What the surveyor needs to do
• Communicate clearly and effectively.
• Practice and understand the consultant role.
• Create professional standing.
• Understand the client’s position.
• Understand what the data is needed for, to be able to inform the client to make a strategic decision.
• Consult with the client with respect to data opportunities and collection methodologies.
• Provide a surveying strategy for the whole life of the project that can be updated as the project progresses, including a survey risk register.
• Suggest suitable survey standards for the project.

Risks the surveyor needs to be aware of
• Lack of input to the strategic direction of the project.
• Lack of standards to conform to.
• Lack of recognition of professional standing.
• Lack of client understanding could lead to the wrong data journey being embarked upon.

The solutions the surveyor brings
• A geospatial opinion will be added to the project strategy.
• All available data will be appraised in a geospatial context.
• Missing geospatial data will be sourced.
Stage 1: Brief

Aim
This is the stage where project objectives and the initial brief will be developed, including quality objectives and outcomes; sustainability aspirations; budget and other parameters and constraints. It is at this time that feasibility studies will be undertaken and site information will be reviewed. The surveyor will advise on, and define the details of, survey requirements.

Typical scenario
Surveyors may join the process at this stage and start to supply coordinated airborne, remote and terrestrial data that will enable strategic decisions to be made. The quality of survey data at this stage will ensure that plans fit well with the existing conditions on site.

Questions the client needs to ask
- What are the geographical extents of the survey/s required?
- What is the capacity of the supply chain?
- What have been the benefits and lessons learned from previous projects?
- What is needed from geospatial data deliverables and what data is already available?
- What data management system will be used?
- What reference system; grid, datum, projection will be used?
- What quality of data is needed, in which format and to what standards?

Risks the client needs to be aware of
- Lack of understanding of the actual purpose of survey data.
- Lack of a common technical language.
- Over-surveying or embarking on a wrongly identified data journey.
- Lack of survey expertise and misaligned expectations.

What the surveyor needs to do
- Communicate clearly and effectively. Provide a glossary and use plain English suitable for all stakeholders to understand.
- Confirm the client’s requirements and expectations, and challenge the purpose of the survey.
- Describe lessons learned from previous projects.
- Identify survey options and provide unbiased advice on best practice and possible improvements to the scope, brief and methodology of the project.
- Confirm the reference system; grid, datum, projection and its suitability.
- Confirm the quality of data, suitable formats and what standards they adhere to.
- Provide a strategy to access the data.

Risks the surveyor needs to be aware of
- Lack of a common technical language.
- Poor project scoping with little practitioner input.
- Poor visibility of strategy and needs.
- Lack of client expertise and experience, and misaligned expectations.

The solutions the surveyor brings
- Survey data will be fit for purpose and the risk of insufficient data will be reduced.
- The survey will be carried out to the brief.
- Data critical to the project’s success will be supplied.
- Survey procedures will be correctly applied and they will be understood by project stakeholders.
Stage 2: Concept

Aim
This is the time when the concept design will be prepared, including outline proposals for structural design; building services systems; outline specifications; preliminary cost information; and project strategies in accordance with the design programme. The surveyor will look at any alterations to the project brief.

Typical scenario
Surveyors may be consulted to clarify unclear data or look at gross errors resulting from field mistakes, for example those stemming from incorrect levels. At this stage site coordination may be refined and the surveyor should advise or confirm suitability of the chosen coordinate system.

Questions the client needs to ask
• Are surveys needed to support the design tender?
• Am I certain of the level of detail, format and structure needed from the survey data?
• What budget is available for survey works?
• What is the realistic delivery timescale to fulfil project requirements?
• Can existing survey information be reused and what updates and verifications are required?
• What survey deliverables do I need to commission and what baseline survey datasets are needed to support the plan of works?
• Does the project survey strategy need to be updated?
• Who needs access to the common data environment?

Risks the client needs to be aware of
• Poor supplier performance.
• Lack of survey budget.
• Poor design definition.
• Failed common data environment.
• Poor survey specification.

What the surveyor needs to do
• Communicate clearly and effectively and advise on survey budgets. Champion the need for sufficient budget to ensure correct coordination.
• Re-confirm the purpose of the survey.
• Confirm the level of detail, data structure and formats required by the client.
• Confirm the site access strategy and discuss any issues.
• Understand what ongoing support for survey data maintenance will be needed.
• Verify the scope and deliverables of the survey works.

Risks the surveyor needs to be aware of
• Poor survey specification.
• Lack of access to site.
• Unrealistic timeframes and expectations from the client on data capture and supply.
• Limited survey budget for the client’s desired scope.
• Lack of collaboration in scope definition and poor understanding of survey purpose and uses.

The solutions the surveyor brings
• Issues resulting from initial contractor mistakes will be highlighted.
• Geospatial design flaws will be detected, for example on larger infrastructure this may be a bridge designed in plane coordinates versus control in national grid.
• The granularity, scale and level of detail of the survey and its suitability for completion of the project will be clarified.
• Time schedules will be updated.
Stage 3: Definition

Aim
At this stage the developed design will be prepared, including coordinated and updated proposals for structural design; building services systems; outline specifications; cost information and project strategies.

Typical scenario
Surveyors will be needed to ensure project elements are in a suitable format for survey tasks and that survey data is easily consumed in the common data environment and is fit for purpose for the end user.

Questions the client needs to ask
• Have volume allocations been made from the multidisciplinary single option design?
• What survey information is needed for verification?
• What survey information needs updating for the increased design definition?
• Do I need intrusive or non-intrusive surveys for the next phase of design?
• What is the budget for this survey phase and the next?

Risks the client needs to be aware of
• Lack of verified survey data supplied to designers and assumptions of survey data reliability that are not identified in the risk register.
• Survey data delivered but not shared or used to its full potential.
• Design programme delayed due to a lack of sufficient survey data.
• Designers underused whilst waiting for required survey data.

What the surveyor needs to do
• Communicate clearly and effectively and offer advice on how survey data can be used and handled.
• Understand how the client and other stakeholders are using survey data and for what purpose.
• Clarify the client’s requirements for BIM levels of detail.
• Clarify timeframes and staging of deliverables for early works.

Risks the surveyor needs to be aware of
• Changes in survey requirements or definition due to poor scoping in earlier phases.
• Late changes in survey scope due to delays in design decision making.
• Unrealistic timeframes and expectations of new surveys based on the design programme.

The solutions the surveyor brings
• Missing survey data will be infilled.
• The survey can be re-purposed and carried out again if project definitions require change.
• Re-surveying to fix issues will inform and update the project timescale.
Stage 4: Design

**Aim**
This is when the technical design is prepared in accordance with the design responsibility matrix. Project strategies will include all architectural, structural and building services information; specialist subcontractor design; and specifications in accordance with the design programme.

**Typical scenario**
Surveyors will check and confirm that the technical data provided is suitable for survey work. They will also ensure that the survey data collected is suitable to update the technical design.

**Questions the client needs to ask**
- What am I assuming to gain from surveys at this stage?
- What is included on the survey risk register?
- How will survey control be maintained?

**Risks the client needs to be aware of**
- Loss of survey control.
- Uncontrollable site changes.
- Significant lag of time and data currency since the last two stages of survey.

**What the surveyor needs to do**
- Communicate clearly and effectively to ensure the client is aware of the advantages of regular as-built data verification.
- Carry out a pre-construction control check.
- Carry out design change verification checks.
- Verify and update site changes.

**Risks the surveyor needs to be aware of**
- Unrealistic timescales.
- Design programme demands and late design change verification checks.
- New project participant specification changes.
- Risk of survey duplication due to lack of ownership and responsibility for previous surveys.
- Lack of continuity in the survey team. The designer and constructor may want to use different surveyors.

**The solutions the surveyor brings**
- Site control will be managed and maintained.
- Design changes will be verified.
- There will be a continuous as-built view as the site is prepared.
Stage 5: Build and Construction

Aim
This is when offsite manufacturing and onsite construction begin in accordance with the construction programme. Any design queries from the site are resolved as they arise.

Typical scenario
Surveyors will manage and maintain site control for setting out activity, and consult and supervise contractors on site to ensure correct coordination is used. The surveyor will feedback regular as-built data to the common data environment to minimise design failure creep.

Questions the client needs to ask
- Who has responsibility for each area of the works?
- At what stages do I need as-built surveys?
- What is the impact of any temporary works?
- How will survey control be maintained?
- How can I avoid emergency surveys?
- How can I overcome clashes?

Risks the client needs to be aware of
- Poor survey control or destruction of survey control by the works.
- Coordination of survey activities (for example monitoring v as-built surveys).
- Not recording as-built data and planning for handover.
- Competence of survey practitioners.
- Continued collaboration between the surveyor and other project stakeholders.

What the surveyor needs to do
- Communicate clearly and effectively the timetable for monitoring and as-built data acquisition.
- Verify construction.
- Set out the works to the approved design.
- Check the availability of survey control and establish new control for setting-out.

Risks the surveyor needs to be aware of
- Poor setting out information.
- Inadequate site access.
- Safety on site.
- Misaligned expectations of new project participants.
- Unclear survey programme requirements.

The solutions the surveyor brings
- There will be a vigilant eye on survey quality and as-built data.
- Updates on site progress and any changes will be given efficiently.
Stage 6: Handover and Closeout

Aim
This is when the building contract is concluded and the completed building or structure is handed over.

Typical scenario
Surveyors may have to re-establish suitable control points with permanent markers if the facilities manager is intending to work on site using geospatial data for navigation.

Questions the client needs to ask
- Have I been handed back the survey control network with appropriate information in a legacy report?
- Have I been issued an as-built model? The as-built model should be a direct digital reflection of the current condition of the completed product.
- Has survey verification of BIM data taken place? This could take the form of additional surveys or photographs that provide evidence that the BIM data is correct at specific construction stages and at the final stage.

Risks the client needs to be aware of
- Lack of survey evidence at construction stages or close out.
- Lack of verification and validation data at close out.
- Complete loss of the survey control network.
- No budget left for the as-built survey.

What the surveyor needs to do
- Communicate clearly and effectively to confirm what the final survey data requirements were at the initial strategy stage. This will ensure that all parties have an understanding of what was required and agreed.
- Question the purpose of the final survey. This will clarify the client's requirements and present an opportunity for any improvements.
- Deliver any final survey requirements.

Risks the surveyor needs to be aware of
- Scope creep and additional requests above what was agreed and planned originally.
- High client expectations. The client may have an expectation or impression that is not aligned to the reality of the data that has been delivered.
- Poor exit strategy and lack of resources. Not understanding what must be delivered and when will lead to incorrect resourcing and programming.
- Not being included in the hand back demobilisation may lead to a catastrophic loss of appropriate resources.

The solutions the surveyor brings
- Any shortcomings of the brief before validation and as-built verification work will be highlighted.
- The site coordinates will be clear and it will be confirmed that the facilities manager understands them.
Stage 7: Operation

Aim
This is the period where the building or structure’s in-use services will be carried out in accordance with the schedule of services.

Typical scenario
Surveyors will locate services in the site coordinate system. They could be party to a service contract by providing data updates to maintain currency of site data.

Questions the client needs to ask
- How current is my data?
- Do I share the data with anyone? Should I share the data internally or externally and with whom?
- How do I manage a large data set and address issues of interoperability; metadata requirements; archiving; future accessibility; and security?
- Who has access to the data, at what level, and how is this set up?
- What is the history and provenance of the existing data?
- Do I have the right level and type of data to make decisions?
- Have I seen a return on investment for the data?
- Is the data spatially coordinated? Is it on a common data platform and does it correlate with different reference systems?
- Do I need to establish a common data environment compatible with computer-aided facilities management?
- Will the data translate from 2D to 3D?
- Does the data comply with current and proposed standards?
- Can I accommodate new versions of data management?
- Who updates the central data environment when changes occur?

Risks the client needs to be aware of
- Access to other people’s data and understanding their quality and provenance.
- Supplier performance.
- Lack of standards, codes and specifications.

What the surveyor needs to do
- Communicate clearly and effectively to clarify format requirements and what they are needed for. For example, layering, coding, descriptions, XYZ coordinates and photography.
- Clarify what grid system the data adheres to.
- Advise on existing data and if it is appropriate for current and future requirements.
- Follow the latest industry standards and guidance.
- Ensure data robustness taking into account accuracy; usefulness; level of detail; quality; and metadata.

Risks the surveyor needs to be aware of
- Liability and collateral warranties regarding data accuracy.
- Lack of a common language and defined terminology.
- Lack of understanding of the objectives and purpose of the data.
- Technical challenges in handling or gathering the data.

The solutions the surveyor brings
- Geospatial data will be consistent and holistic.
- Unbiased advice will be given on the survey strategy to suit data management.
- Geospatial data and information will be used in the correct manner.
Summary

Back in 1840, the engineer Joseph Whitworth said: “You can only make as well as you can measure.” Two centuries later, when BIM will be commonplace in all construction projects, the same words will still apply. Measuring with precision — the skillset of the surveyor — is critical in the making of any construction; whether it spans a single site or counties; or straddles a drainage network or river.

Survey is a key driving element of the BIM process and the surveyor is not only a key supplier and curator of content, but also a vital stakeholder in a project’s success.

Further reading

BIM Task Group
www.bimtaskgroup.org

BIM Toolkit and Digital Plan of Work
www.thenbs.com/bimtoolkit

Survey4BIM
www.bimtaskgroup.org/survey4bim/
Glossary

**BEP**
BIM execution plan. This is developed for each project at inception and ensures all team members work to a uniform set of standards. This document is developed on a project specific basis, addressing the employer’s information requirements.

**BIM Toolkit**
An online library of thousands of level of definition templates and a unified classification system. It also includes a digital plan of work template.

**CDE**
Common data environment. The single source of information for any given project, used to collect, manage and disseminate all relevant approved project documents for multidisciplinary teams in a managed process.

**COBie**
Construction operation building information exchange. A data standard that can be used in spreadsheets to supply data to the client for use in decision-making tools, facilities and asset management systems.

**EIR**
Employer’s information requirements. This is part of the wider tender document for the procurement of the design team and contractor. It sets out the information requirements and establishes the information management requirements. It forms the basis from which bidders can then respond with their outline BIM execution plan.

**GSL**
Government soft landings. An initiative to gradually handover buildings and structures to the owner/operator to familiarise themselves with the building management systems.

**DPOW**
Digital plan of work. This defines who is doing what and when throughout a construction project. It will gradually grow with the project as more information is generated from the employer’s information requirements through to the BIM execution plan, then the master information delivery plan and the design responsibility matrix.

**LOD**
Level of detail. The geometric representation of the deliverable that is required.

**LOI**
Level of information. The associated information of the deliverable that is required.

**Uniclass 2015**
The unified classification system that covers the whole construction industry. It comprises classification tables from large objects such as built facilities down to small construction products.
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