Acknowledgements

I would like to thank everyone I have met over the last few months who have wanted to share with me their ideas and hopes for progress through the use of digital tools in the construction industry, often with great enthusiasm.

I would also like to thank all the construction stakeholders who have taken the time to make written contributions, which constituted a plentiful, constructive stock of documents on which I have drawn widely in this report.

In particular, I warmly thank Pierre Mit, Frank Hovorka, Antoine Ferré and the Plan Bâtiment Durable (sustainable building plan) team, Jérôme Gatier, Thomas Matagne and Natan Leverrier, for the support they gave me during this mission.

I am also very grateful to the CSTB, and particularly Souheil Soubra and Olivier Teissier, for their help, particularly with the writing of this report.
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Summary

The “Numérique et Bâtiment” (“digital technology and construction”) mission is part of the plan to revitalise the construction industry launched last May by the Ministre du logement, de l’égalité des territoires et de la ruralité (minister of housing, regional equality and rural affairs). Digital tools are promising avenues for innovation in the sector, and represent concrete ways of responding to the plan’s objectives: building and renovating more housing of higher quality, including environmental quality, at a lower cost.

The mission was an opportunity for large-scale consultation with a full range of industry stakeholders. It aroused a great deal of interest: nearly eighty contributions have been published on the dedicated website (http://mission-numerique-batiment.fr) and, as of the date of submission of this report, I will have met about 130 professionals in the public and private sectors covering all the construction trades. These contributions and discussions demonstrate the degree of the profession’s maturity with regard to the subject and the agreement on the benefits of developing digital modelling.

Digital tools are already very present in the construction trades. In terms of design, for example, architects have been working with 3D modelling tools for many years, and engineering offices have increasingly powerful dedicated tools for incorporating growing numbers of parameters into the technical design stages. Construction workers are themselves equipped with computers and smartphones and exchange information electronically with their partners. Estate managers have software tailored to their needs for building operations, repairs and maintenance.

Digital modelling is the key innovation in the sector, as it has a potential impact on all aspects of construction. It provides a virtual avatar of the building which contains its geometric properties and information about all the objects used (composition, properties etc.). This tool is in the process of profoundly altering all construction processes. BIM (Building Information Modelling), based on collaborating around a digital model, is gaining ground as a working method. The model can be built up with additional information from different people working on the building, from design to construction, acceptance and end of life. This allows everyone involved to better represent, anticipate and optimise their decisions throughout the life of the building.

Large organisations (contractors, architects, engineering firms and manufacturers) are making more and more use of this new tool, which has gradually been more and more widely adopted internationally for major projects. On the other hand, it is still little used by smaller organisations, except for a few pioneers convinced of its benefits, even for existing projects. Feedback from these initial trials has all been very favourable, and no-one who has tested it can imagine turning the clock back. According to all the experts, these tools promise very significant potential gains in terms of productivity (saving time and cutting costs) and improving project quality. These gains can be expected not just in new construction, but also in building renovation and estate management throughout a building’s lifetime.

Internationally, more and more initiatives to develop BIM are being undertaken; European partners are demonstrating very proactive strategies; the European Union has recently amended the directives relating to public procurement to encourage member states to make use of digital tools. This context is favourable for accelerating its adoption in France. The government must act without delay to avoid being left behind by competitors, and to ensure that French companies get the benefit in international competition.
The government appears justified in promoting an ambitious national strategy. Construction players are waiting for the government to announce a target for the spread of BIM and digital tools and to support players in the sector in the gradual adoption of these tools. However, this does not mean imposing the use of 3D digital modelling and BIM in their most complete form on everyone. The increase in their use must be gradual, and the degree of information and detail contained in the model will depend on the project and the context.

By setting the direction and showing the route, the government can mobilise and lead all players towards significant progress in the world of construction. The government can expect to leverage its investment and create jobs with high added value. Its action could be organised according to two perspectives: (i) establishing a permanent framework of consultation and governance with the various public and private stakeholders and (ii) setting up a series of high-visibility structural actions designed to create an initial ripple effect based on the following four main areas:

1. Convincing and inspiring all stakeholders, especially project owners
The goal is to inspire construction professionals, including small and micro-businesses, to use these tools and methods. The actions will involve (i) promoting the approach through competitions and calls for projects, feedback and demonstrations, (ii) illustrating as precisely as possible all the possible benefits and the pitfalls to avoid, (iii) gathering and preparing a corpus of reference documents (particularly for the guidance of project owners) and educational kits to popularise the techniques. Creating a national digital portal and organising networks of stakeholders would make most of these actions possible.

2. Responding to stakeholders’ needs for equipment and improved digital skills, particularly among SMEs/micro-businesses.
Without the necessary resources in terms of equipment and skills, players in the sector, particularly SMEs/micro-businesses, will be unable to take advantage of the benefits of more widespread digital tools. Actions to remove these obstacles will involve (i) encouraging and multiplying options for continuing training such as the specialist master’s in BIM from the ENPC (national civil engineering school) and ESTP (higher school of public works), (ii) developing a wide range of online training tools to reach as many people as possible without building workers having to travel, (iii) promoting the learning of these tools in initial construction training and (iv) supporting the initiatives of collective platforms pooling access to hardware and software resources.

3. Developing tools suited to the size of any project
Not all the players involved in a project need to access all the information contained in the digital model, and not all projects need an extremely detailed model in the first place. The goal is to develop tools suited to the size of the project and the players involved (i) by developing specifications appropriate to different trades (from design to operations) to stimulate supply by software publishers based on real needs, (ii) by creating “BIM kits” suited to small projects and helping companies to collaborate and ultimately group together, (iii) by stimulating new techniques for capturing data from existing buildings quickly and cheaply to support renovations and building operation.

4. Establishing confidence in the French digital ecosystem
To ensure that BIM can indeed be used to manage interfaces better and share information of better quality, interoperability between software and data formats that anyone can use are essential. From this perspective, the proposal is (i) to organise and support France’s representation (the interests of its construction industry) in European and international standardisation bodies (CEN and ISO), (ii) to prepare libraries of components and generic construction systems for the industry’s use, (iii) to set up a trust system appropriate to the tools, stakeholders and projects.

To put this action plan into effect, the government must play a pilot role, supported by the professional organisations that represent all construction players and cover all the phases of a project’s life cycle (project ownership, project management, manufacturing, contractors, operators).
1. Context and objectives

1.1 / A FAILING SECTOR

The construction sector is failing. Production has not stopped falling since 2008, except for a slight recovery in 2011; its level at the end of 2013 was 13% lower than in 2007. Jobs are following the same trend, disappearing continuously since 2008 – at the end of 2013 the figure was 7% below that of 2008. The 2014 figures are not encouraging. According to the FFB (French building federation), new housing projects begun in 2014 are close to their lowest ever level, with 290,000 to 300,000 homes started (compared with 273,579 in 1999). The new non-residential market in 2014 is also among the lowest in the long term. The market for repairs and improvements was also down in 2014.

Although there are a few positive signs for 2015, they remain weak. Firstly, building permits for residential construction were slightly up in the third quarter of 2014 compared with 2013. Secondly, the draft finance act for 2015 recently adopted by the National Assembly includes measures to relaunch the housing sector and promote the energy transition. In this context, promoting digital modelling appears a promising avenue for increasing the sector’s competitiveness and productivity while improving project quality and moving towards the very ambitious quantitative targets set by the government.

1.2 / A PLAN TO RELAUNCH THE HOUSING SECTOR

Since May 2014, the minister of housing, regional equality and rural affairs has been mobilising the public authorities and construction professionals behind a plan to relaunch the housing sector by accelerating the speed of housing construction and renovation. The plan incorporates the national priorities embedded in the draft Energy Transition for Green Growth law, particularly with regard to energy improvements to housing.

As part of this relaunch plan, the minister wants to encourage innovation responding to three goals: building more housing, of higher quality including environmental quality, at a lower cost. In this quest for improved productivity, communication technologies including digital modelling will play a central role. Digital tools encourage the development of a global approach throughout a building’s life cycle, optimising interfaces and facilitating greater collaboration between professional roles. They constitute avenues for progress to optimise the definition of the building according to its ultimate use, to encourage collaboration as early as possible between all the professionals involved through a common language and platform and to manage repairs and maintenance throughout its life.

In the construction sector as elsewhere, digitisation and paperless operations will constitute key elements in businesses’ competitiveness. In other industrial sectors (automotive, aviation, aeronautics etc.), significant progress has been made as soon as value was analysed and the global chain of operations, from design to production, was redesigned. In construction too, using powerful tools such as digital modelling, well suited to information sharing and collaborative working, it is now possible to increase the precision and relevance of the design phases for the benefit of the subsequent production and then operations/maintenance phases.

1.3 / THE LETTER OF APPOINTMENT: SPOTLIGHT ON BIM

This is the context in which Sylvia Pinel, the minister of housing, regional equality and rural affairs, entrusted me on 24 June with the task of preparing an operational roadmap for digital technology applied to the construction sector (see letter of appointment in the appendix). The mission aims firstly to clarify the state of French expertise in the subject, its strengths and weaknesses, and secondly to identify strategic
and operational areas for development that will lead to the widespread use of digital tools by all construction stakeholders by 2017.

The letter of appointment defines a very wide field of reflection. The BIM (Building Information Modelling) process and digital models are at the heart of the mission¹; how can all the players in the sector be encouraged to adopt these tools and benefit from the quality and productivity improvements they bring? According to experts and early adopters, BIM improves the design, construction and operation processes at every stage by informing choices better and enabling the risks and requirements of subsequent phases to be anticipated. However, the development of BIM still raises a number of technical, organisational and legal questions that need to be examined and that need operational responses. Above all, spreading “BIM for all”, regardless of the size of the company and the project, is the real challenge. How can we be sure that all the conditions are met so that BIM can be adopted by everyone and gradually make headway in public and then private procurement?

The letter of appointment also includes the themes of training and construction site organisation tools within its scope. Training is an essential condition for increased skills in this area. Incorporating digital technology from the initial training stage would prepare the ground for these tools to be used in the market; digital platforms would constitute pathways for progress in continuing professional development. The spread of tools for site preparation and support would also improve implementation quality.

Finally, the letter of appointment also mentions a number of additional areas for reflection, such as the potential of digital technology in processes for operating smart, connected buildings and cities.

1.4 / THE NEED TO TAKE ALL THE BENEFITS OF DIGITAL TECHNOLOGY INTO ACCOUNT

More generally, the gradual but large-scale introduction of information and communication technologies into the construction sector is at the heart of this mission’s thought process. The digital revolution first affected sectors producing goods or services that could easily be separated from physical processes (consumer goods, books, music etc.), but it is now reaching all sectors. For construction and property professionals this is a new transition that can and must be seen as an opportunity.

For professionals at all levels, the integration of digital tools should enable more information to be shared, which can generate time and productivity gains and facilitate the development of the market. Introducing new technologies into professionals’ daily lives is also an opportunity to evolve certain practices. This is the case with training tools, for example: without replacing traditional training, the creation of open online courses (MOOCs) constitutes a disruptive innovation that should be considered with interest.

The construction sector is also currently undergoing another revolution: the energy transition. These two transitions, energy and digital technology, should take place simultaneously, with the potential to reinforce each other. For example, support for all construction stakeholders in the energy transition involves the creation of dedicated, shared digital tools. This issue has been identified as fundamental if energy improvement targets for buildings are to be achieved.

While these transitions are sometimes experienced by some professionals as a threat to their business, the sector has already taken hold of these questions and many practical solutions have been established or are being developed. The deployment of digital technology in the construction sector will involve progress in the uses of digital technology in all its aspects. These innovations must be followed closely to support projects making a positive contribution to the sector’s transformation and ensure they have their full impact.

1.5 / THE METHOD

The method used for this mission is based on a process of broad consultation with professionals in the sector, and this report relies heavily on the contributions made both by professional representatives and the economic players themselves.

A call for contributions from the profession was issued during the summer and covered widely in the specialist press. Nearly eighty contributions have been published on the dedicated website: http://mission-numerique-batiment.fr. All these contributions demonstrate the degree of the professionals’ maturity with regard to the subject and of agreement on the benefits of developing digital modelling. Extracts from some of these contributions are quoted in boxes to illustrate the

¹/ From here on we will use the following definitions. BIM is a working method based on collaboration around a digital model. The “digital model” is a 3D model that incorporates information about the nature of all the objects used. For example, a wall is no longer just an extrusion of a set of lines in two dimensions but an object consisting of layers of different materials with their own structural, thermal and acoustic properties.
current state of practice and expectations in the sector.
I personally met all the stakeholders who requested an interview. In all, as of the date of submission of this report, I will have met about 130 professionals and representatives of professional organisations in the public and private sectors, covering all the construction trades.

A plenary meeting was organised on 30 September 2014. This brought together about forty professional organisations and players from the sector (see the list of participants at the meeting in the appendix). It confirmed the general support in the industry for wider adoption of BIM and digital tools and the expectation of a commitment from the government.

This report draws heavily on recent publications on these topics; the density of these publications confirms the subject’s dynamism in the sector. References include:
- Plan Bâtiment Durable report of March 2014, “BIM et gestion du patrimoine, un avatar numérique de l’ouvrage et du patrimoine au service du bâtiment durable : le Bâtiment et Informations Modélisées (BIM)” (BIM and estate management, a digital avatar of buildings and estates in service of sustainable buildings: Building Information Modelling), arising from the work commissioned by Philippe Pelletier, President of Plan Bâtiment Durable, from Pierre Mit (Untec) and Frank Hovorka (CDC);
- Cahiers pratiques du Moniteur magazine issues of March and May 2014, “Le point sur BIM (Building Information Modelling)” (review of BIM) and “Le point sur BIM/Maquette numérique, contenu et niveau de développement” (review of BIM/digital modelling, content and level of development) (in collaboration with Syntec-Ingénierie and BIM France);
- White paper from the Caisse des Dépôts et Consignations public finance body of April 2014, “Maquette numérique et gestion patrimoniale, Préparer la révolution numérique de l’industrie immobilière” (Digital modelling and estate management, preparing for the digital revolution in the property industry);
- Plan Bâtiment Durable report of October 2014, “Rénovation des logements : du diagnostic à l’usage, Inventons ensemble la carte vitale du logement !” (renovating housing: from diagnosis to use, let us invent a healthcare card for housing), arising from the work commissioned by Philippe Pelletier, President of Plan Bâtiment Durable, from Emmanuel Cau (Vice President of the Nord-Pas de Calais Regional Council) and André Pouget (Director of the consultancy firm POUGET Consultants);

Finally, the approach builds on a series of national actions aiming to stimulate the adoption of digital solutions in the building sector:
- The Ministry of Industry has issued several TIC&PME 2015 calls for projects involving ICT and SMEs, aiming to stimulate the use of digital solutions in SMEs. The BIM-2015 project submitted by Mediaconstruct was selected, and is part of the dynamic initiated by the eXpert project, selected five years ago for TIC&PME 2010. It includes a first section, “Quotes and BIM”, supervised by the FFB and a second section, “Software certification”, supervised by the CSTB;
- ADEME and the Ministry of Industry issued a call for research projects and a call for expressions of interest under the “Investissements d’Avenir” (Future Investments) programme involving the construction sector and containing a “digital” component;
- After an initial consultation in 2013 on the constitution of a corpus of contractual terms for digital modelling projects, the PUCA (urban development, construction and architecture plan) launched a second consultation in 2014 on “reproducible” BIM trials. These calls for projects aim to promote best practice and support innovation;
- As part of the “Nouvelle France Industrielle” (new industrial France) programme initiated by the Ministry of the Economy, the building energy renovation plan led by Mr Pestre (Groupe Point.P) and Mr Torrents (Delta Dore) has delivered its roadmap. It includes a focus on digital tools, and particularly the development of 3D scanning systems, which constitute an important avenue for progress in the creation of digital models based on existing buildings.
- Mediaconstruct is a not-for-profit association created in 1989 to support the spread and the adoption of new information and communication technologies in the building sector. Since the mid-1990s, the association has been working on software interoperability within the framework of the OpenBIM standard for open digital modelling. Medi- aconstruct is the French representative of BuildingSMART International, which is responsible for a set of standards relating to digital modelling (including ISO-IFC).

This report cannot hope to cover all the programmes and initiatives in progress in this area. Actions are being taken at national level with regard to standardisation, training etc., and initiatives at local level in competitive clusters, research centres and businesses are legion.
A few definitions to start with

A “digital model” of a building is a 3D model that incorporates the building’s geometrical characteristics (sections, plans, elevations etc.) and information about the nature of all the objects included (composition, physical and mechanical properties, behaviour etc.). For example, a door is represented as a swing door or a sliding door, made of aluminium with double glazing (attribute) and it opens (behaviour).

**BIM (Building Information Modelling)** is a working method based on collaboration around a digital model. In a BIM design process, each construction player uses the same model, initially designed by the architect, and draws from it the information they need for their work. In return, they feed new information into the model, so that the end result is a virtual object that perfectly represents the construction. The digital model is updated throughout the life of the building, from design to construction and from delivery to demolition. This gives the project owner a true virtual avatar of the structure and a powerful tool for managing and optimising the building throughout its life.

The ideal BIM, with a shared model updated by everyone involved, is an idealised vision that may become a realistic proposition in the coming years. For the moment, it raises a number of questions that remain to be answered, particularly in terms of the legal responsibility of the different parties involved. In reality, the transition to BIM must take place step by step.

We distinguish between **three levels of BIM:**

**Level 1 BIM** corresponds to the creation of a digital model and information flow in one direction at time t. **Level 2 BIM** corresponds to collaboration based on a digital model with two-way information flow between the architect, engineering firms and contractors. The model should allow for exports but also for importing information from collaborators. This collaboration can begin gradually with one or two collaborators, and incorporate more contributors as projects advance and mature. **Level 3 BIM** corresponds to the use of a single digital model shared over a network between all the parties involved, who can connect to it and make changes at any time. This “concurrent” engineering process raises the question of how the digital model is produced and updated. “BIM Management” thus becomes a central function in the BIM project. The **BIM Manager** is not a new role, but rather a new function which can be performed by various people involved in project management.

**The IFC (Industry Foundation Classes) format** is the data model used for digital modelling. It allows objects (walls, windows, spaces, pillars etc.), their characteristics and their relationships to be described. The IFC formats are part of the international STEP (STandard for Exchange of Product data) standard (ISO 10303) In March 2013 IFC was given the label ISO 16739. The goal of IFC is to ensure that BIM software is interoperable.
Overview of the use of BIM in construction

2.1 / A VERY STIMULATING INTERNATIONAL CONTEXT

Internationally, more and more initiatives to develop BIM are being undertaken. These constitute a favourable context for accelerating its adoption in France. They are also an invitation to act without delay to avoid being left behind by competitors, and to ensure that French companies get the benefit in international competition.

First of all, the European parliament adopted a new version of the directives on public procurement (EUPPD) in early 2014. The European parliament recommends the use of digital processes such as BIM in public contracts to improve the efficiency and quality of discussion during the call for bids and competitive tendering phases of public projects. The member states have until April 2016 to transpose the new rules into their national legislation. Once the directive has been transposed, each member state can encourage or require the use of BIM for construction projects financed by public funds.

Moreover, some countries have already structured national plans to promote BIM. The UK published a report on strategy in the construction sector in May 2011. Its stated aim is to reduce investment and carbon emissions in new construction by 20%. BIM is identified as one of thirteen levers able to contribute to this target. Level 2 BIM (corresponding to basic exchanges of digital data) will become mandatory from January 2016 in all public contracts with a value of more than £5 million. The national plan is based on a sector-wide BIM Task Group working with the government ministries involved, architects, engineers and construction companies to overhaul public procurement procedures.

Apart from this example, the best known in France, several countries have adopted very proactive policies in this area. In Finland, Senate Properties, a public body that manages some of the state’s assets, made BIM (in IFC format) mandatory on 1 October 2007. In Norway, digital modelling has been required since 2010 for all projects (construction/renovation) conducted by Statsbygg, which manages the state’s property assets.

In Germany, the initiative is more recent but just as ambitious: the government’s aim (Mittelstand Digital, Industrie 4.0) is to stimulate the creation of an organisation dedicated to BIM developed using private funds. Outside Europe, the USA has been scaling up BIM since 2003, while in Asia, Singapore, South Korea and Hong Kong are pioneers.

The approach in the USA is decentralised. Several states and public administrations have adopted the policy of supporting the spread of BIM with their own specific features (thresholds for application, contracts involved etc.). The GSA (General Services Administration), which manages the PBS (Public Buildings Service), has required BIM rendering as a precondition for access to its public contracts. More recently, NAVFAC (Naval Facilities Engineering Command) has announced that it will use BIM for the design, construction and management of all US Navy buildings. Finally, in 2013, the National Association of Home Builders, which includes all private American building firms, announced its support for standardised digital modelling, following the recommendations made by the non-governmental organisation NIBS.

In Singapore, the BCA (Building and Construction Authority) established a digital modelling roadmap in 2010, aiming for 80% of projects to be built using BIM by 2015 and 100% by 2016. The BCA estimates that this should result in

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2/ In the UK, the construction sector represents about 9% of gross domestic product (GDP), £110 billion per year in turnover, of which 40% is accounted for by the public sector alone.
2.2 / CONVINCED PRACTITIONERS

The major construction and public works groups and engineering and architecture firms are convinced of the benefits, and consider that they could no longer do without BIM. BIM modelling is seen as a way of improving the accuracy of study documents at all stages of the project, from design to maintenance, and anticipating the problems to be resolved throughout the life of the building.

As well as the benefits in terms of accuracy and consistency, the use of digital modelling leads these players to think about their working methods and how they manage projects. BIM is presented very positively as a new way of managing project studies that is concurrent and collaborative and provides early information.

In practice, these major players are gradually deploying 3D tools to replace their 2D tools. The deployment strategies and rates vary between companies, disciplines and sizes of projects. Internationally, large-scale projects systematically impose the development of a digital model at the design stage.

2.3 / MICRO-BUSINESSES/SMES REMAIN CAUTIOUS DESPITE CONVINCING EARLY EXAMPLES

Micro-businesses and SMEs have made less progress than major groups in digital modelling. They face two main obstacles: skills and equipment (hardware and software). In terms of equipment, the extra investment to move from 2D to 3D has been evaluated at several thousand euros per workstation (a range of €8,000 to €15,000 according to CINOV, the French federation of consultancy, engineering and digital services). In terms of skills, active professionals need to be trained in these new tools under conditions appropriate to small construction companies.

Note that the cost of moving to digital modelling and then to BIM processes is not the same for all players, and that the associated investments are different:

– for those already working with digital models, the transition to BIM just means better information structuring, following the recommendations of the project’s BIM charter and configuring the IFC filter to be able to exchange information properly with the other parties involved;

– for those moving from 2D to 3D modelling, this means an initial change from AutoCAD to tools such as ArchiCAD/Revit/Allplan;

– for small businesses or sole traders, it may be enough, at least at first, to download a free viewer (such as Solibri or Tekla BIMsight) to view the digital model and better understand the project as a whole and in detail. Specific, easy-to-use tools will also become more and more common on mobile devices such as tablets.

However, there is no shortage of programmes aiming to spread digital tools in the wider sense. Some are supported by professional organisations, others are the result of individual initiatives. Without seeking to be comprehensive, we could quote several very convincing experiments:

– CAPEB (the confederation of building trades and small contractors) has developed the “MonBât” application, a platform for exchanging administrative and technical data, as part of a competitive tender for the Ministry of the Economy (TIC-PME 2010, eXpert 2). This tool allows projects to be monitored and managed digitally and facilitates the use of collaborative tools. It is particularly well suited to small companies;

– tradesmen will be called on to use digital tools more and more via the distributors and suppliers of materials and products. For example, these companies are developing interactive terminals in their sales outlets, enabling tradesmen to access suppliers’ technical catalogues quickly and put together quotes and orders. These tools will soon be
accessible online, offering more and more sophisticated services; several construction clusters (Eskal Eureka, SE2E, Pôle Alsace Energie Vie, Eco-énergies, Astus, Domolandes etc.) are developing actions relating to digital modelling aimed essentially at local SMEs. For example, Eska Eureka has pooled the acquisition of a 3D scanner.

### CAPEB
Gradually acquiring IT equipment since the 2000s, small companies have entered the field of e-operations (exchanging data with banks, searching for technical and regulatory information etc.) more and more quickly, and many of them are already equipped with smartphones and digital devices. CAPEB offers the application MonBâti, a collaborative site monitoring platform specially designed for small construction firms. The application provides a simple, user-friendly interface enabling the different operators working at a site to share information in real time.

### FFB
The FFB is currently supervising the BIM 2015 “Quotes and BIM” project, designed to interface between BIM-IFC digital models and the management software used by contractors. The goal is to avoid the risk of mistakes and duplicated data entry as far as possible. Pilot projects to build structures using BIM-IFC are also being finalised in two regions. The FFB has undertaken to pilot at least two projects a year in different regions to obtain feedback (positive points and areas for improvement) in order to raise awareness among companies throughout the country. The FFB is at the forefront of the eGovBst project in Basse-Normandie, launched by Pole-Tes, which aims to computerise the whole chain from the tendering process, generating standard tender documents based on the digital model, to the final invoice. Project managers, contractors and public project owners are all involved and collaborating in the project. It has also created the e-btp portal, which offers over forty online services (monitoring calls for tender, bidding, issuing electronic certificates etc.) in order to familiarise SMEs with electronic operations. The FFB is a member of the Mediaconstruct association, which it supports actively in its work to standardise IFC.

### AIMCC
The AIMCC has contributed to the construction sector’s entry into the digital age by initiating the creation of the AFNOR PP BIM standardisation committee and chairing it. The aim has been to create a standardisation approach that would be credible in the eyes of both French and international construction players and IT service providers targeting these industries. […] The first data about a construction project, its design and implementation (apart from data about the land) are data about the products and construction systems to be used. Without reliable digital processing of product data, there can be no complete BIM process. Hence the need to deal with this preliminary stage successfully, with an international focus from the outset.

### 2.4 / MANUFACTURERS ARE INCREASINGLY INVOLVED
Major manufacturers are already very involved in the computerisation of the sector. They are working to convert their product catalogues into e-catalogues for online business. Manufacturers, unusually, are equally involved in digital data processing both upstream and downstream – upstream for data associated with manufacturing (supplies, inputs and components, maintenance of production tools...), and downstream for data associated with commercial exchanges (sales data, transport, handling, deliveries etc.), design and construction (BIM). Manufacturers thus have a key central role on which digital information for the whole sector depends. Important questions remain about the definition and representation of “objects”, or assemblies of products, in BIM. There is no standard for describing these assemblies and meeting professionals’ needs. These considerations were shared in a “Product Room” by the AIMCC, the professional association for manufacturers of building products, and professional organisations within Mediaconstruct. For these reasons, the AIMCC is working in the area of standardisation to ensure consistency between semantic product information at national, European and international level in the production of e-catalogue content and exchanges. This has led to the creation of the AFNOR PP BIM standardisation committee. This committee, whose first task was to complete an analysis of other standards requirements in the sector, produced a supplement to the ISO-IFC standard, the XP P07-150 standard, a method for defining and managing the
descriptive properties of products and systems for BIM and other digital exchanges, with the ultimate aim of producing a European reference system for product properties. This experimental standard is being taken further (i) at European level by the CEN/BT WG 215 “BIM”, which is preparing a programme of work for a future CEN TC BIM, and (ii) at international level by Mediaconstruct as part of work on the BuildingSMART bsDD.

It should also be noted that the Edibatec association, which includes about 100 manufacturers working with the technical building trades, provides a database format (currently being integrated into “BSDD”) for:
- Simplifying the language for data exchange between construction players
- Standardising technical data exchange formats to be used by technical specification tools
- Facilitating access to technical data in electronic form

2.5 / PROJECT OWNERS ARE BEGINNING TO MAKE A COMMITMENT

Project owners have made a decisive commitment to gradually computerising their assets. The Burgundy regional council has played a pioneering role: it initiated its own project in 2003 and now has a digital model of all of its property assets (about 900 buildings, 2.5 million m², mainly secondary schools). The white paper from the Caisse des Dépôts et Consignations is based on a study of eleven trials by public and private project owners, drawing conclusions from these very comprehensive digitisation programmes. In all, these eleven case studies cover nearly 100,000 social housing units, 4 million m² of surface area of regional council property, nearly 1.2 million m² of teaching and research facilities and nearly 7 million m² of tertiary property.

2.6 / TOOLS THAT ARE STILL BEING PERFECTED

3D design packages are multiplying and becoming increasingly sophisticated, gradually incorporating more and more features and role-based views. However, there is still a lot to be done. A very sensitive area for attention concerns interoperability between software packages, and the need to develop standards for data and communication between applications. One international norm is covered by an ISO standard, IFC (Industry Foundation Classes); most of the software publishers in the French market have adopted this standard, which is promoted by the Mediaconstruct association. But managing imports and exports of IFC data between one application and another is still not entirely satisfactory. The IFC model is permissive, which makes automated operations difficult. Work still needs to be done to specify the parts of the model necessary for each stage of a project.

What’s more, the applications that could be imagined for the various construction trades are virtually limitless, and would require significant development to make them compatible with the IFC format and able to interact directly with the digital model of the building: design tools for structural, thermal, acoustic and aeraulic calculations or verifying stresses; site applications to support construction, layout and compliance with standard practice; tools to check compliance Habitat 76 (28,000 homes)

The SIGTP project (IT system for technical property management), launched in 2009, bears the “projet d’entreprise” (business plan) label, and the team behind it reports directly to senior management. Property data is the lifeblood of the company, which is why the project has “projet d’entreprise” status, as it affects core business processes. In particular, the project is developing 3D tools in the two areas of design/construction and operations/maintenance, with a consistent vision between the two approaches. The knowledge base is built up through the technical management and global operations activities (tenancy management, inventories etc.). As it is a living body of data, the digital tool is developed to make it easy to incorporate evolutions.

Groupe LEGENDRE

Scanning existing buildings is a very important challenge, especially on an industrial scale. It is almost always possible to build a digital model based on a surveyor’s readings and plans, but it is not reasonable to imagine doing this for the entire French building stock. Capturing existing buildings, which the most recent technologies claim to enable, and transforming them into BIM models are major developments to be pursued and supported in the coming years. Without this, all renovation projects or projects involving existing buildings risk being excluded from this revolution from the outset.
with planning regulations and acceptance tests; applications for management and maintenance, control over energy consumption etc. These applications embody the issues specific to the families of roles listed below.

3D scanning constitutes a specific digital tool, a means of digitising existing buildings for a reasonable cost. This is a major requirement: without such a tool, the existing building stock, the majority of property assets, risks being left behind by the digital revolution and the productivity gains expected to reduce the cost of energy improvements may be difficult to achieve.

In addition, the time will come when the interaction between the scale of the building and the scale of the city has to be taken into account. To meet the challenges of sustainable development, it is vital to integrate buildings into their environment, or even adopt a systemic approach in which the building and its environment are considered as a single, complex system whose components exchange flows of energy, materials and information (link with smart grids, smart cities, eco-districts etc.).

Several structural themes lie at the interface between these two scales: networks and infrastructure, which are currently a very dynamic subject for digital modelling in Europe (see for example the intention of CEDR – the Conference of European Directors of Roads – to launch a collaboration on the subject of adapting BIM processes to roads). Depending on the parties involved and the stage of the project, this infrastructure must link with the engineering elements in the BIM and the components of urban space.

The difficulty in achieving this coming-together relates to the fact that the work associated with each of these two scales arise from two different spheres which address different levels and are organised by different standardisation bodies with different standards:

- The BIM sphere, at the scale of the individual building, is organised around the work of ISO and buildingSMART (ISO/IFC standard).
- The geographical information sphere at the scale of the city is organised around the work of the OGC (CityGML standard) and the INSPIRE initiative.

These two spheres must be brought together to address the complex, multidisciplinary issues of construction and sustainable planning, and this must involve continuity of information from building to city via urban infrastructure.

ADEME

Like what used to happen in the past, when models of building projects were inserted into a model of the surrounding site (town, district), the possibility of plugging a digital model of a building into a wider model will quickly and inevitably become a requirement so that the context of the construction project can be taken into account in terms of terrain, resources, climate, networks and flows available (energy, transport etc.), regulations, amenities etc., but also conversely, for the benefit of the local community for example, to predict the project’s impact in terms of networks and energy needs (smart grids?), transport and mobility requirements, parking, housing in the case of a commercial building etc.
Challenges for stakeholders

All parties agree that BIM is a tool that will enable a leap forward in terms of quality and productivity in the building and property sector. Through all the stages of a building’s life, BIM makes it possible to optimise decisions, anticipate needs and manage technical and organisational interfaces; it should also reduce delays and cut the overall cost of the building while ensuring compliance with increasingly stringent requirements (environmental, health etc.).

The parties are convinced and several studies support these claims, but the expected productivity gains remain to be demonstrated because time is needed for all the stakeholders to fully adopt these new methods and for the gains to compensate for the investment in the tools.

In any case, the potential gains are closely linked to the significance of each stage in the life of the building in terms of its global cost; as a first approach, we can expect that the economic stakes will be higher in the operations/maintenance phase, which lasts more than fifty years and accounts for more than two thirds of the overall cost, than in the design/construction phase, which only lasts three to five years and accounts for a third of the global cost. This question will be addressed in the action plan, as it needs to be clearly demonstrated to lead all the professions in this direction.

According to the Association pour l'Analyse de la Valeur, the French value engineering association (see the MIQCP (interministerial mission for public construction quality) guide to the quality of public construction), 65% of the savings that can be achieved on global cost are only possible if the right decisions are taken during the design phase.

3.1 / ATTRACTIVE BUT IMPRECISE POTENTIAL GAINS

Launching their BIM Task Group in 2011, the British government announced expected savings on projects of about 20%!

What does this mean? Given the cost of land, taxes and other auxiliary costs, the cost of construction (design and works) represents just part of the overall cost of a project: a figure of about 40% is often quoted. The savings on this 40% will be split between design and construction, whose respective weights (currently 10/90) will be modified by the use of digital tools.

While the use of digital modelling and the BIM process is likely to increase design costs by 20%, we can hope for a fall in construction costs due to reduced delays, savings on materials and fewer mistakes of about 30%, so the potential saving on construction costs works out to 25%, or about 10% of the project cost.

Finland, which has a head start on BIM in Europe, announces the following figures for housing construction: contractors’ margins have risen by 45%, waste has been cut by 45%, site accidents are down 5%…

The large Swedish company Skanska quotes some exemplary successes: the construction of a hospital for a much lower cost (€2.5 million), the use of tablets on site cutting return trips between the office and the site by half…

Discussions with the French players with the most experience in digital operations (major construction and public works companies, the biggest engineering firms such as Egis etc.) emphasise above all the productivity gains associated with better control over information throughout the project, benefiting the contractors on site, who have access to more precise, better-shared information.

In its contribution with regard to savings, the FFB mentions a
survey it conducted that reveals savings of up to €35/m² for new-build and about €2.30/m² per year for estate managers. The potential savings are even greater for all building repairs, maintenance and operation work.

The white paper published by the Caisse des Dépôts in early 2014 presents the economic benefits of digital operations for estate managers: social housing providers can save up to 7% on their maintenance budgets, a public-sector body saved €1.5 million on 2.5 million m² of property and in global terms return on investment for estate managers is very fast (less than three years)…

These evaluations do not take into account the potential additional value of property resulting from digital control: it could be expected that property that comes with a complete information system (digital model, history of all operations etc.) will ultimately be worth considerably more on the property market than buildings with 2D plans at best.

Several commentators have underlined the considerable increase in project quality generated by the widespread use of digital technology, which could greatly reduce claim rates (30%), the overall cost of which is estimated at an order of magnitude of €15,000 million per year in France. Insurers and loss adjusters are taking a close interest in these digital tools and methods, seeing strong potential in terms of improving the management of risk.

Consideration should also be given to the prospects for creating high-added-value jobs based on the use of digital control – this is a generational issue in adding value to the sector, and could make it much more attractive!

Expectations and challenges vary considerably from one discipline to another. They depend in particular on the software and tools already available, initial feedback and professional practices.

3.2 / PROJECT OWNERS

Project owners who have been able to experience digital modelling are convinced of its usefulness and request it systematically in their project specifications for both new buildings and renovation work.

3D modelling enables project owners to be truly involved in the project. From the design phase, it makes the project much easier to grasp and to understand. It allows all the requirements and constraints (regulatory, geotechnical, geometric, planning-related, architectural etc.) to be incorporated early in the process so that decisions can be optimised. It facilitates discussions with the project manager starting from the feasibility study and throughout the design phase. The data of the digital model can also contribute to optimising the administrative and financial processes associated with the construction.

In work on existing buildings, 3D modelling also appears very useful for communicating with project management and monitoring the progress of the work. In mixed-ownership buildings, digital modelling enables greater transparency and hence greater trust and allows the landlords to vote on the work.

Union Sociale pour l’Habitat (USH) (social housing union)

Given the production and management targets in the “Pacte d’Objectifs et de Moyens” and “Agenda HLM” social housing agreements it has signed with the government, USH wants the deployment of digital modelling to improve deadlines and production costs for new-build and renovation, contribute to greater control over maintenance costs and upkeep for both the operator and tenants and generate real improvements in quality and reliability.

Mediaconstruct

All the work on the BIM, from the beginning throughout the stages of the project, is addressed primarily to the clients/building managers, the real beneficiaries, who remain inadequately informed on the subject. They hold the keys to the widespread adoption of BIM and the benefits for the whole community.

As well as design software, the first digital tools already exist for sending all the technical documentation on the project to the non-professional project owner. For example, Qualitel has set up the GISELE platform, which takes care of transferring the DOE completion documents, the DIUO maintenance documents and the instruction manuals for technical equipment to the project owner. Although not yet a true digital model, this tool gives joint owners easy access to information about the building, helping them to take charge of their property and maintain it in the long term.
Challenges for stakeholders

3.3 / ESTATE MANAGERS

The white paper on digital modelling from the Caisse des Dépôts et Consignations identifies public-sector project owners as the main beneficiaries of electronic data about property. They have to buy, maintain, operate and add value to buildings over an average period of fifty years. They must be able to respond at any time to regulatory requirements, performance targets and demands for savings with increasingly scarce public money. Knowledge of their property, and the ability to share this knowledge, are made possible by digital modelling. Project owners, public or private (who face the same problems), can now require all their partners to work with a single, dynamic knowledge base of property data for which they set the scope, requirements, functions and contributions to their disciplines as for the building itself.

3.4 / PROJECT MANAGERS

Digital modelling and the associated BIM processes represent progress for all the parties involved in design. These collaborative tools make it possible to retrieve information from colleagues (at least partly) without having to re-enter it, and to enhance it with their own results. BIM is a way of moving from traditional “sequential” engineering to “concurrent engineering”.

The expected gains for project managers (and project owners) are many:

– limiting the need to re-enter data; optimising exchanges between parties by standardising data formats and improving the technical quality of data through the new attributes that can be associated with them;
– optimising the project by facilitating larger numbers of iterations, with earlier analyses but increased quantities of parameters;
– ensuring the project’s real feasibility in all its technical and geometrical details; checking all the constraints;
– generating consistent documentation throughout the project, right up to the DOE/DIUO; ensuring the traceability of interventions, essential in terms of liability.

Architects are the first people concerned with the digital model, which they are very quickly called on to create, either by reflex for those who have already adopted this approach and can no longer work without it, or at the express request of the project owner. Right from the initial planning and then the preliminary design stages, digital modelling offers very attractive possibilities for communication and information sharing and proves a very efficient tool to support dialogue between the architects and their partners.
Architect François Pelegrin

In the area of architectural work to reclassify mixed-ownership buildings, the digital model is first of all an explicit representation of the project; it enables the landlords to understand their building and to visualise it within its environment. Thanks to the viewer, everyone can walk freely around and inside the model on their tablets! This saves time in understanding the property and the improvements proposed following a shared global diagnostic…

Architects’ enthusiasm for the deployment of digital modelling is also reflected in their joint work with manufacturers (including small companies) through schemes such as the Club BIM Prescrire, organised by the UNSFA architects’ union, which aims for better control over prices on behalf of the project owner through involvement as early in the project as possible.

On the other hand, while it is clear that architects are keen supporters of these tools, questions remain as to their appropriation by wider numbers, in terms of hardware and software investment but also, and above all, in terms of recognition for their role as the initiator and creator of a digital model whose use will benefit all disciplines: claims are being made with regard to copyright, intellectual property and remuneration for a new task and a new responsibility.

Finally, it should be noted that architects are particularly attentive to issues relating to intellectual property. Means will have to be found to clarify the IP associated with the digital model (the information it contains, the uses that can be made of it etc.).

Efficient collaboration systems are now widely welcomed but still face a number of obstacles: the difference in maturity between project management players; the use of industry-specific software packages, often with incompatible proprietary data formats; inadequate remuneration insufficiently spread between disciplines for the development and maintenance of the shared elements of the digital model; the temptation for project owners to minimise the study phase when finances are stretched etc.

UNTEC

These new tools should optimise the work of economists by eliminating data duplication, and we can use the time saved to calculate the figures. It is not enough to describe and quantify; we must also produce the most objective prices possible, taking the economic context into account.

OGE - Ordre des Géomètres Experts
(order of surveyors)

The model will be the medium for the design, layout and renovation of real estate assets subject to public and private easements, which must be identified precisely with regard to increasing urban density and the inviolability of property rights. It will also provide a basis for the creation of real estate assets, plots, units in mixed-ownership buildings and spaces which the surveyor must describe and guarantee, if possible with full access to the BIM.

SYNTEC Ingénierie

Putting BIM processes in place provides support for the sharing of up-to-date information about project progress within the various project management teams. These processes aim to provide greater transparency and visibility for everyone’s work.

This type of process is thus an essential support for the development of concurrent engineering, which many see as indispensable if sustainable development issues are to be incorporated properly into the construction sector. Collaborative tools provide value by improving the efficiency of interfaces between pairs of disciplines (project owner–project manager, project manager–contractor etc.) and within all the relationships in the sector.

3.5 / PROPERTY: DEVELOPERS, AGENCIES

The regulations require a large amount of data to be produced when transactions take place, including inspection reports or maintenance logs for boilers and chimneys; other voluntary information such as certificates or performance labels may also be provided. Most of the time, all these documents are in paper form.

To streamline the process, the draft act on the energy transition and green growth plans to impose a “digital monitoring and maintenance logbook” for new housing from 2017 and for existing housing from 2025. The digital model and the associated BIM process will be able to complete this “digital logbook” automatically. They will constitute the natural source of data to supply all the information needed to
the prospective purchaser or tenant. They can also feed into the “energy renovation passport”, a component of the “digital logbook” which aims to help households plan and monitor work by builders to improve the energy performance of their home. The digital model could thus provide substantial added value for the property development and rental sectors.

3.6 / CONTRACTORS

The expectations of building contractors from digital modelling vary according to their size. The digital model promises progress in several areas:
– easy availability of measurements, reduced construction times, minimised construction errors and risks of pathology due to better site preparation and organisation;
– simultaneous increase in the abilities of companies working together and subcontractors through the sharing of data and information in collaborative mode;
– traceability of materials, quality process and performance guarantee;
– integration of prefabricated and pre-manufactured elements; reduced quantities of unused materials.

3.7 / MANUFACTURERS

The major manufacturers (and some smaller ones) are converting their product catalogues into e-catalogues for digital communications, including BIM. The AIMCC is working via its PP BIM committee with national, European and international standardisation bodies to draft a standard that would guarantee the consistency of semantic product information in digital exchanges, including BIM. Ultimately, it is expected that the properties of products and equipment standardised in this way could be used directly by the digital model and associated industry tools to optimise the project to the finest level of detail.

The issues in renovation work, which tends to be done by SMEs and individual tradesmen, are the same. Digital tools should enable better organisation of the trades involved and greater precision in the execution of the work thanks to better preparation of the site. Here 3D scanning tools could provide crucial assistance to ensure operations are properly calibrated and prefabricate certain components.

New tools are emerging, whether or not they feed into the digital model, and could quickly take over on building sites to improve productivity: 3D printers for producing missing parts or replacing inappropriate ones, connected objects making it possible to schedule works based on actual site data (condition of surfaces to be plastered, access for heavy machinery etc.).

Certain obstacles remain, however. Full use of BIM will require changes to the ways companies are organised; the cost of access to these technologies may discriminate against and possibly exclude small companies; ease and simplicity of use are also concerns – tradesmen would love tablets adapted for use on site etc.

The Digital Construction Mission / REPORT

Bouygues Construction

We are convinced that the most promising element of digitisation is this ability to reinforce collaboration between different players. This makes it possible to move from a “sequential iterative” operating mode, where each player can only optimise their own production based on choices inherited from previous stages, to projects in “organised collaborative” mode, in which it becomes possible to mobilise and seek agreement between “the right people at the right time on the right subject” at all stages of the development, thus optimising quality, deadlines and overall cost.

AIMCC

What we have seen is that so far there is no definition, validation or precise list of the properties for defining either a requirement or a value associated with a product or system so that they can be incorporated and shared within BIM. Yet most of these properties have been defined (standards, regulations, industry rules etc.). So if model information is exchanged properly using IFC, the semantic information about the products and systems is communicated inconsistently and is thus of little or no use for the technical calculations that could be carried out following these exchanges.

This properties knowledge base is thus a vital supplement to the ISO 16739 standard on IFC. It should be incorporated into BIM tools by software publishers so that it is accessible by professionals, and manufacturers should refer to it when producing their data catalogues and connect them to BIM tools.

For small manufacturers, it is very important to be able to use this knowledge base of properties to generate their e-catalogues simply, so that their products can be known about and specified in projects.

Beyond the major factors of distributing commercial information about materials, products and systems, manufacturers
are aware of the prospects offered by these digital tools for optimising structural components to suit different projects: manufacturers will be able to use the digital model and, taking account of the notion of a prototype inherent in any building, produce tailor-made pre-manufactured elements, considering as early as possible the technical interfaces with the other construction trades and thus considerably reducing deployment times.

3.8 / WHOLESALERS

Wholesalers are an important element in the value chain for advising and supporting contractors, especially individual tradesmen. They constitute a special opportunity for tradesmen to improve their skills. This is very important in helping the energy improvement market to take off and achieve mass adoption while controlling costs and acting on the twin levers of supply and demand.

In line with the plans announced by the French president on 12 September 2013 to stimulate France’s industrial competitiveness, the “REB - renovation énergétique des bâtiments” (energy renovations for buildings) industrial plan aims to build up an integrated, competitive supply of French industrial services in terms of energy improvements for buildings.

The REB plan incorporates several interesting dimensions for the use of digital technology in the sector, particularly with regard to interoperability in home automation (the CONFLU-ENS project), aiming to develop a metalinguage for devices positioned between the electricity meter and the telephony, Internet and home equipment operators enabling them to communicate with each other and with the network for fine-grained control over comfort and consumption at the user’s discretion.

Finally, the “energy renovation passport”, which should keep track of all the changes made to a building in order to facilitate future works, and especially those aiming to improve energy efficiency with individual tradesmen as the main player, will emphasise still further the role that can and should be played by wholesalers as a mechanism for transferring innovation from manufacturers’ innovative solutions to the national issue of renovating existing buildings on a large scale.

3.9 / PUBLIC-SECTOR PLAYERS: GOVERNMENT, REGIONS AND LOCAL AUTHORITIES

As indicated above, the white paper on digital modelling from the Caisse des Dépôts et Consignations identifies public-sector project owners as the main beneficiaries of electronic data about property. Gains are to be expected in all the stages of managing building stocks.

However, the importance of digital technology and BIM processes for these players goes beyond estate management. It could potentially affect the whole built environment at the level of a district or a town, including the construction and management of public infrastructure and networks. For example, the application for a building permit, from the submission procedure to processing the application, could be partially automated if applications were submitted in a digital model format. This kind of process would lead to greater speed (reduced permit award times), transparency and quality.

There are plentiful examples of administrative processes that could be improved by electronic means and the standardisation of exchanges: issuing planning permission, processing funding or insurance documents, putting together technical documents for public services etc. These are likely to be sources of considerable productivity improvements for public-sector bodies. In the same spirit, all the mechanisms for processing organisations’ qualifications and certifying products or buildings could gain greatly in efficiency by using digital tools and processes, more or less connected to the digital model; Qualibat is currently examining the possibility of digitising the process for analysing companies’ applications for the RGE environmental label to drastically cut processing times.

Globally, timescales of five to six years for new construction operations are excessive and could be significantly shortened through the widespread use of digital tools for conducting administrative and financial processes: the design and construction work itself is much quicker.

3.10 / AUXILIARY BODIES: BANKS, INSURANCE, MANAGEMENT AGENTS ETC.

The digital model should make it possible to reduce the level of risk in building management. Firstly, it offers better guarantees with regard to the quality of the design and construction. Taking a greater number of parameters into account, more in-depth studies at an early stage, error detection and better collaboration between the parties should diminish the risk of quality failings and pathology. Secondly, it allows users to capitalise on high-quality information throughout the life of the building and anticipate future needs in the management of technical, environmental and social risks. Overall, a building with a digital model should offer better economic performance with optimised management costs, including lower insurance premiums. Consequently, digital modelling is
of interest to the finance, loss adjusting and insurance fields, as well as property managers, to take better account of risk, better determine responsibility and move towards differential pricing depending on stakeholders and projects.

However, the use of the BIM model itself raises a number of new legal questions: who is responsible for the data in the model as it changes over time? What is the legal validity of the data if disputes arise? These questions raise a number of new risks that need to be addressed, but are not likely to curb the spread of these tools.

In conclusion, going beyond its usefulness and its positive impact on construction or renovation (reducing costs and increasing quality), it is clear that the value of the information collected and represented in this way will revolutionise the perception of the building for both professionals and private individuals.

The standardisation of digital formats in construction and estate management, and its corollary, data interoperability between all stakeholders, allows us to envisage a real breakthrough of information systems in the construction sector. This will be supported by the exponential growth of available and accessible data (whose acquisition cost will have been minimised) and the parallel development of user-friendly tools such as 3D visualisation and applications on mobile devices etc.

In this way the BIM process, based on the use of digital modelling of the building or property asset, will become an essential tool for sharing data, risk analysis and thus value creation.
An ambitious action plan supported by the state

Though the involvement and adherence of the professional organisations and major groups is certain, it is clear that the current development of BIM in France is still limited, especially among the smaller players in the industry. The risk of a two-tier distribution is that many of the benefits of BIM, which are based on a collaborative, unified approach, would be lost. In this context, taking inspiration from the approaches of our European neighbours, the state appears justified in putting forward an ambitious strategy. Stakeholders are waiting for the government to announce a timetable of incentives or progressive obligations to use digital tools, to organise and lead dialogue between players and to coordinate and support initiatives to create a digital ecosystem.

By setting the course and showing the way, the government can mobilise and lead all the players towards major progress for the construction world: the state can expect a leverage effect on its investment such as the creation of high-value jobs and the additional and significant mobilisation of the major economic players (contractors, engineering firms, manufacturers).

Large-scale action by the government, involving as many stakeholders as possible, would be desirable in terms of promoting the Energy Transition for buildings, improving the competitiveness of businesses in the sector, rationalising public expenditure and implementing the European directive on “BIM and modelling tools.”

This action needs to be organised according to two perspectives:

1. Establishing a framework for continuing consultation and governance with the various public and private stakeholders, including those outside the sphere of housing (Ministry of the Economy, Industry and Digital Technology, Ministry of Culture etc.) and integrating other key initiatives such as the REB energy renovations plan (within the framework of the NFI roadmap) in order to share information on the current situation, establish a pathway for progress and identify key milestones;

2. Implementing a series of structural actions with high visibility with the aim of producing an initial momentum according to four main areas set out in detail below:
   - Convincing and inspiring all stakeholders, particularly project owners;
   - Meeting stakeholders’ needs for equipment and digital skills, including micro-businesses and SMEs;
   - Developing tools suited to all sizes of projects;
   - Establishing confidence in the Digital Ecosystem.

Not all these actions will take place at the same time. Some can be launched immediately, and will quickly produce a ripple effect and begin the momentum. Others will require additional consultation with representatives of professional organisations and will necessarily need more time to bring out enough of a consensus. Preference should be given to a situation where all stakeholders gradually reach different “levels” of involvement in BIM.

It would also be desirable to commission an operator to monitor the actions envisaged and the consultation with the professional organisations representing all the players in construction across all the stages of a project’s life cycle (project management, manufacturers, contractors, project owners, operators).

Finally, a reference platform to ensure efficient interoperability, taking charge of monitoring standardisation activities (AFNOR, ISO, CEN, BuildingSMART) and promoting them from the perspective of open, standardised BIM, should be put in place around a Mediaconstruct type of organisation.
An ambitious action plan supported by the state

Axis 1
Convincing and inspiring all stakeholders, especially project owners

OBSERVATION
The use of digital modelling has been spreading among stakeholders (project managers, contractors etc.) over several years. However, its use remains limited and its integration into a BIM process is still not very widespread in France (a few dozen projects identified to date). In general, it tends to be the larger organisations that have mastered and use these tools and associated procedures as part of major projects in France and abroad; other uses, on smaller-scale projects, are starting to develop but are harder to spot as they receive less publicity.

Before these practices can be adopted more widely, and before any consideration is given to making them mandatory in public procurement, as many stakeholders as possible, and particularly project owners, must be convinced and inspired to join in.

POSSIBLE ACTIONS
We must identify and analyse current trials to give visibility to best practice in the use of digital tools and BIM processes at different stages of projects.

The analysis of these projects should highlight, qualitatively and quantitatively, the necessary investment on the one hand and the savings and benefits for stakeholders and in terms of both productivity (cost, time) and projects quality on the other.

It must also demonstrate the relevance of using digital modelling and BIM on smaller projects organised by enthusiastic project owners, particularly in the public sphere (public housing agencies, regional councils, local authorities etc.). As the number of projects and trials in progress is relatively low for the moment, we must amplify the movement by leading a discussion circle specific to public and then private project owners and offer interested stakeholders a programme of project ownership support tailored to the implementation of digital tools and procedures in public construction and renovation projects.

Recommendations and guides for project owners and their partners need to be developed based on initial feedback to:

– demonstrate to public and private project owners and project managers that the current regulatory framework (law on public-sector project owners, public procurement code etc.) is compatible with the collaborative approach of BIM processes based on the digital model. This could be based on standard public procurement contracts for project managers incorporating the use of the digital model developed by the CNOA;

– clarify the roles, remuneration and responsibilities of stakeholders in the digital model.

In parallel, the state as a project owner could make a commitment to the digital modelling of its own property assets, beginning this large-scale work in the short term with a view to achieving significant savings:

– give the state a role as an example by accompanying several high-profile new construction and renovation operations with the launch of an ambitious programme to model the stock of public buildings digitally.

Educational kits will be needed to explain the full meaning and scope of these tools to as many stakeholders as possible (micro-businesses/SMEs) in suitable vocabulary.

A digital building portal could highlight and provide access to best practice, documents explaining the concepts and approaches, details of companies and software etc. for everyone and help to assess changes in the appropriation of these tools through online surveys at regular intervals.

Action 1.1. Digital Building Portal

Educate the professional audience in the digital transition by creating and operating a Digital Building Portal in the form of a website accessible free of charge to all stakeholders. This portal will serve to enhance and promote the following actions:

– Analyse current experiments in new construction and renovation using digital tools, and draw the clearest possible lessons in terms of the necessary investment and benefits (cost, time, quality etc.)

– Provide information on best digital practice and educational kits to raise awareness

– Encourage the use of digital tools in public-sector projects and bring out the accompanying guides and recommendations necessary

– Promote the example set by the state in construction and renovation by launching an ambitious programme to model the stock of public buildings digitally.
Action 1.2. Study of the conditions for wider adoption of the digital model

Following an initial phase of analysing current experiments, work with representatives of professional organisations to develop an action plan to gradually spread the use of digital modelling.

Care should be taken to address all stakeholders covering the whole territory. Local actions must be undertaken. We must support initiatives to develop collective platforms for access to hardware and software resources that will enable working professionals to learn about digital tools close to home. The first examples are already in development: a platform will be launched in the Landes in early December 2014, similar initiatives are in the pipeline in Alsace, the Pays de Loire and Rhône Alpes and probably also in other regions. More generally, networking between local initiatives, similar projects and similar players appears to be a useful way of sharing experiences and expertise in the regions. This could take the form of one or more national networks.

Action 1.3. National network of local initiatives

Build and manage a national network based on local initiatives, particularly regarding the sharing of hardware and software for local stakeholders to discover and explore digital tools. Government leadership of this network will make it possible to organise cross-fertilisation between these platforms and maximise their efficiency.

A specific dissemination plan should be developed. This should include, for example:
– Identifying projects that have successfully used digital tools to serve as examples to be followed and create a form of emulation through a national competition organised every year (e.g. Golden BIMs)
– Identifying the players with recognised expertise in the field on behalf of project owners and managers through appropriate markers of trust (which should be based on qualifications, continuing training, the resources used and project references)
– Offering players a charter of voluntary commitment to the use of digital modelling and BIM in order to measure professional expectations and gradually confirm the possibility of making the use of these tools mandatory and the conditions of such an obligation
– Establishing a communication plan (conferences, media events, exhibitions etc.) to present the benefits of this digital transition to as many stakeholders as possible

Action 1.4. Promoting the value of the digital approach

– Organise an annual competition for the most successful projects in the country using digital technology
– Establish markers of trust appropriate to the players in the sector to enable project owners to call on teams that have recognised expertise or are identified within the proposed grouping for the use of digital tools. This could be achieved through the development and promotion of a “digital quality” label accessible to small companies.

MAIN RESULTS

A Digital Building Portal in the form of a website accessible free of charge to all stakeholders will:
– provide visibility for best practice in digital modelling and BIM in construction/renovation/management projects
– provide a view of how the appropriation of digital tools by professionals is evolving
– answer stakeholders’ questions in the use of these tools (project owners, project managers etc.) based on suitable educational kits
– offer tailored support services for project owners, targeted primarily at public-sector clients
– gather all the relevant reference documents together: definitions, guides, recommendations, examples etc.

A National Network set up and run by the state, based on local initiatives for pooling hardware and software, to enable local stakeholders to discover and explore the use of digital tools. The network will be promoted via the digital portal. The promotion plan for the digital approach will include:
– A national annual competition promoting best practice
– Markers of trust adapted to the needs of stakeholders
– A voluntary commitment charter to be signed by the players involved
– A communication plan (conferences, media events, exhibitions etc.) to present the benefits of the digital transition to as many stakeholders as possible
Axis 2

Responding to stakeholders’ needs for equipment and improved digital skills, particularly among SMEs/micro-businesses

OBSERVATION
If we can succeed in inspiring stakeholders, two barriers will need to be overcome in order to spread the use of digital technology more widely: skills and equipment (hardware and software):

– Working construction professionals have not been trained in the use of these tools. Tens of thousands of players of all types will need to be initiated in the use of these new tools: architects – project managers, engineers, technicians, contractors, tradesmen – and they will need solutions enabling them to acquire the necessary skills under conditions suited to small organisations.

– In parallel, efforts will be required to make computers and software suitable for the use of digital modelling available to all stakeholders. Some options may require hardware and software tools powerful enough to handle digital models (3D); in this case the extra investment is evaluated at up to several thousand euros per workstation (range of €8,000 to €15,000 according to CINOV). This level of power is needed above all for the most complex design tasks; it will not be necessary at all levels and we can therefore hope to limit the average investment.

POSSIBLE ACTIONS
New continuing training packages should be encouraged and promulgated, such as the BIM specialist master’s from the ENPC and ESTP and their partners, the first year of which is highly successful but only includes about forty professionals.

Options based exclusively on physical presence are not well suited to small construction companies and working professionals: the MOOC (Massive Open Online Course) avenue is more suitable; online training materials on digital modelling and BIM processes should be developed and operators encouraged to invest (specifications, trials etc.). The success of these new digital training tools will require structural support to promote projects, ensure their visibility and build trust by ensuring the quality of content.

In parallel, we must support the inclusion of introductory and teaching programmes in the use of digital tools into initial training courses in construction (vocational schools with construction training, technical schools, BTS vocational training, higher-education institutes, universities, engineering schools, schools of architecture etc.), going beyond the commonly used office tools.

Action 2.1. Initial and continuing training

Promote continuing training options such as specialist master’s degrees in BIM, working with schools of engineering and architecture.

Develop e-learning repositories on digital modelling and BIM; trial and deploy the use of MOOCs for digital technology, especially in the context of continuing training for construction companies.

Formalise agreements on introducing the use of digital tools within the national education system, higher education and schools of architecture.

Resource pooling initiatives (hardware and software) are emerging in some regions (Aquitaine, Alsace, Pays de Loire, Rhône Alpes etc.) to accelerate the discovery and appropriation of digital tools with real projects; these initiatives should be supported and developed.

In parallel, wholesaler initiatives aimed at tradesmen and construction micro-businesses/SMEs using digital tools as mediation platforms between the supply and demand for materials, products and equipment should be encouraged as they can, firstly, contribute to the discovery and appropriation of these tools and, secondly, improve the rationalisation of ordering.

Action 2.2. Resource pooling platforms

Promote and develop resource pooling platforms (hardware and software) for local stakeholders, working with local authorities, to help them discover and adopt digital tools.

Analyse and support mediation platforms between the supply and demand for materials, products and equipment.

Coordinate these platforms nationally with the aim of ensuring the consistency of tools and methods.
MAIN RESULTS

Training repositories in the use of digital modelling and BIM available free of charge for continuing training operators.
Examples of online training courses suited to small organisations identified and accessible via the digital portal.
Agreements with the Ministry of Education, the Ministry of Higher Education and the Ministry of Culture to ensure the presence of initial training on digital modelling and BIM processes in all courses targeting the world of construction.
Development and management of a network of resource pooling networks (hardware and software) with sufficient coverage for the whole country.

Axis 3

Developing tools suited to the size of any project

OBSERVATION

The use of digital tools is based on the management of information about the construction/renovation project in order to enhance the collaboration between stakeholders by improving interfaces (project owner/project manager, project manager/contractor, contractor/operator etc.) throughout the life cycle of the building. Information must thus be shared, reliable and durable in terms of the building itself and its immediate environment (infrastructure and networks: fluids, energy, waste etc.). Various initiatives have been launched recently relating to the concept of a building health logbook (“carte vitale du logement” or housing health card, “passeport de la rénovation énergétique” or energy renovation passport, …), and these have been given concrete form via the draft energy transition bill as the “carnet numérique de suivi et d’entretien du logement” (digital monitoring and maintenance logbook). These initiatives highlight the importance of shared production and access to information with a view to operating and renovating buildings better.
Initial feedback on the practice of digital modelling and BIM processes highlights the need to analyse the information flows necessary for communication between the parties for the design and construction process and to clarify their respective roles and the data models that will support these exchanges for each project before studies and construction begin. These analytical efforts, always specific to the project, are out of the reach of small companies: for smaller projects and the deployment of digital technology at all levels, we need tools that are “ready to use” and geared to the business processes applied by these players.
Finally, the combination of design data and data gathered during the operational phase opens new horizons for optimising renovation operations. We can hope to improve the quality of use and reduce the overall cost (works/operations) while improving transparency about the risk of obsolescence and the impact on the property value.
The operator, having access to design data, can take the specific characteristics of the building into account in managing and optimising the control over energy use and comfort. The latest work by the UNEP FI property working group shows that much information about the sustainability properties of buildings is collected at one time or another in the life cycle of the building as a result of the building codes and regulations, financial and non-financial reporting, procedures for obtaining certification etc. However, this information is rarely preserved or reused in the process of making technical and especially financial decisions. Most of the information needed to assess the sustainability of property assets already exists, but its use is hampered by a lack of systematic processes common to the different trades. The financial work involved in implementing such systems would be amortised through their use in environmental management and reporting. The BIM process would thus become a central tool of the ecological transition in buildings.

POSSIBLE ACTIONS

Reference materials need to be developed to describe processes, role-based views and dictionaries suited to the national context and to relatively small projects; these documents will be made available to software publishers to allow the development of a range of appropriate tools.
Actions must be targeted at different stages of projects:
At the planning level: for those who use it, digital modelling, with its 3D visualisation capability (viewer), demonstrates its effectiveness as soon as the dialogue between the project owner and the project manager begins. This clear observation must be shared as widely as possible by facilitating use in public and private contracts; at this point it is mainly architects who are involved and the investment is within their reach.
At the level of administrative and financial authorisation: the use of digital tools, and digital modelling in particular, will simplify processes and shorten timescales for...
the benefit of both professional stakeholders and the services concerned, whose image will thus be modernised and strengthened. The example of the building permit is often highlighted by professionals as a necessary evil today, but it could quite naturally be processed on the basis of a digital model of the project containing all the necessary information including location data. This remains to be demonstrated, and could be trialled as long as at least one administrative authority volunteers. Cities such as Rennes, Le Havre, Blagnac and St Quentin en Yvelines, which already have experience of similar experiments, could usefully be approached. Nevertheless, the transition can only be gradual; the standard processing of building permits (based on 2D graphical documents) would remain, but processing could be accelerated if the applicant provided a digital model. Other processes also need to be moved towards this digital transition: applications for funding, electronic processing of social housing planning decisions, certification of buildings (individual homes, collective housing, tertiary buildings), qualification of companies, RGE labelling…

**Action 3.1. Digitisation of administrative and financial processes**

Demonstrate and promote the feasibility and value of digital technology in the context of administrative and financial processes: building permits, planning of social housing operations, certification of buildings, qualification and certification of stakeholders etc. by:

- Experimentation and demonstration of its relevance with competent volunteer authorities
- Development of recommendations and guides for stakeholders and services
- Development of the tools and applications necessary for wide adoption

**For studies:** “ready-to-use” solutions (BIM kits) consisting of tools for creating/managing digital models, based on libraries of standard structures, for small construction/renovation projects and basic applications (techniques, surveys, estimates etc.) should be developed on the basis of specifications tailored to needs (architectural and technical project managers, economists, contractors) which, subject to the development of software that meets these needs, will guarantee the reliability and durability of the tools, necessary conditions for their adoption by small building companies.

**Action 3.2. BIM protocols**

Formalise BIM protocols in consultation with the relevant professional organisations, defining the information exchanged between parties at each stage of the project and the associated responsibility. These BIM protocols will then be made available to project teams wishing to integrate a BIM dimension and specific support measures will be deployed for their use.

**Action 3.3. BIM kits for micro-businesses/SMEs**

Develop BIM kits (hardware, software and services) geared to the needs of micro-businesses/SMEs including construction tradesmen to avoid a rupture in the sector between those who can keep up with the dynamics of digitisation and the rest:

- Develop and supply open source tools free of charge for manipulating digital models (viewer, SDK, checking tools etc.). These open source applications will complement the applications produced by the major IT players;
- Develop libraries of BIM objects in the cloud allowing micro-businesses/SMEs to make light use of BIM as a service (BIMaaS) on tablets and entry-level machines without having to install specific licenses. Preference should be given to a French “sovereign” cloud;
- Support micro-businesses/SMEs in the acquisition of the necessary equipment through a secured investment bank loan (through a bank guarantee) or packaged support (to gain feedback on the experience of BIM projects). Tax incentives, as well as integration into the research tax credit system, could also be considered.

**Action 3.4. E-tendering**

Develop a “digital tender document” kit to promote e-procurement, including the appendices to the specific administrative specifications on design and works setting out the contours of the tasks that can be performed by BIM and the basic technical specifications (formats, execution protocol).

**For the construction site:** avenues for progress are emerging and should be analysed to develop and promote digital tools suited to the phases of works (cost, time, accuracy, comfort, safety): resource allocation, implementation
monitoring, on-site fabrication (3D printers), self-checks, management of reserves etc.

**Action 3.5. Digital tools for the construction site**

Develop and promote digital tools for the construction site (cost control, deadlines, accuracy, comfort, safety):

- Analysis of the possibilities for site preparation and anticipation of logistical constraints in the case of projects involving BIM;
- Support for the development of equipment and tools suited to construction sites: support for implementation, self-check tool, noise and pollution control, etc.

**On acceptance of the works:** to ensure the continuity of the information system between the design and construction stage and the operations/maintenance/management stage for the benefit of building managers, it is quite possible to develop digital DOE and DIUO documents to be handed over on acceptance based on project data attached to the digital model.

**Action 3.6. Digital DOE and DIUO**

Enable delivery of a digital DOE and DIUO on acceptance of the works to ensure continuity of information in the operational phase. This means developing a DOE and DIUO “role-based view” adapted to the different BIM definition levels and offering suitable methods and tools before testing and validating the approach with project owners and managers.

**For renovations of existing buildings:** this requires the most targeted diagnostic possible, and it is essential to make progress towards the semi-automatic creation of digital models directly from existing buildings (photogrammetry, laser measurement etc.). These are tools and techniques that are within the reach of small companies/SMEs and that will accelerate the critical phases of diagnosing and preparing for renovations.

**For the management of building stocks:** applications based on the use of digital models need to be developed in order to facilitate all decisions regarding the use, operation and maintenance of existing buildings stocks: initial experience (Burgundy regional council, Habitat 76…) highlight the rapid return on investment and significant progress in planning renovation operations.

New methods of digital data management must also be set up including:

- data banks dedicated to the entire life cycle of the building, with data hosting enabling value-added services to be provided (collection, validation, hosting, provision and maintenance of data);
- Specific data management for maintenance/renovations should be offered to public and private stakeholders:
  - checking the configuration over time: does the object react correctly (monitoring the building)
  - how does the asset evolve over time: renovation, ageing, impact of changes to the site
  - support in evaluating environmental compensation

**Action 3.7. Digitising existing buildings for management and renovations**

Develop and promote tools and methods suited to the creation of digital models from existing buildings. This means organising active monitoring on an international scale on the subject of tools for creating digital models of existing buildings (laser measurements - Scan3D, photogrammetry, infra-red thermo-imaging etc.) and then selecting the most promising avenues and supporting the first application trials to eventually promote the best solutions to stakeholders (surveyors, diagnosticians…)

Spread the use of digital modelling for building stock management:

- Develop the building operator’s data repository (“role-specific view”);
- Support the development of an online software ecosystem for property management and maintenance support with easy access for small companies.

To ensure access to the information throughout the operating life of the building, or even beyond, consider collaborative platforms for managing digital data.

**For building conservation:** digital models are tools that can remember the operations carried out throughout the life of the building and should make it possible to provide answers to the dual problem of the archiving and traceability of interventions.
Action 3.8. Digital actions for the conservation of public assets

Emphasise the value of the digital model for property conservation:
• Demonstrate the relevance of the approach via a few flagship projects
• Develop guides and recommendations adapted to archiving operations and the traceability of interventions on public buildings.

For the digital monitoring and maintenance logbook: while this will be imposed for all new homes from 2017, discussions need to begin quickly to clarify its contents and how it will be completed: plans, descriptions of structures and equipment, operating and maintenance manuals, all associated or not with a digital model… These considerations can be based on the recent work of the Plan Bâtiment Durable working group on the “health card”.

Action 3.9. BIM and the “digital monitoring and maintenance logbook”

Produce a technical definition of the digital content of the “digital monitoring and maintenance logbook” for housing mentioned in the energy transition law, specifying the conditions of use of BIM and potential conditions for using the digital model to feed into this digital housing logbook.

Establish an initial operational version of the digital logbook.

MAIN RESULTS

Computerisation of administrative and financial processes: building permits, planning social housing operations, building certification, qualifying/certifying stakeholders…

BIM protocols defining the type of information exchanged between players in each phase of the project.

BIM kits (hardware, software and services) geared to the needs of micro-businesses/SMEs.

Specifications of a digital tender document

Feedback and specifications for digital tools at construction sites.

Specifications of a digital DOE and DIUO when the building is completed.

Specifications for the development of tools and methods for the rapid creation of digital models from existing buildings.

Specifications of generic applications for estate managers

Guides and recommendations for the use of digital tools for property conservation.

Specifications for the supply of data for digital logbooks for housing from a digital model.

First operational version of the digital monitoring and maintenance logbook for housing.

Axis 4

Establishing confidence in the French digital ecosystem

To ensure that players in the construction industry can develop the use of digital modelling through the specific features of their business, they will need reassurance about the quality of the data exchanged in terms of compliance with standards, trust (traceability and guarantee level, margin of error) and sustainability over time. They will therefore need:

– neutral, stable data formats for describing buildings that will be the basis of digital models, tailored for software interoperability and the development of open source applications;

– to feed digital models with information on construction materials, products and equipment in formats that can be used by all the manufacturers and wholesalers in the French market (about 7000 brands);

– be able to rely on tools and organisations in which they have full confidence;

– to be able to benefit from reliable, secure, long-lasting data throughout the entire life of the building (over 50 years);

– to have an appropriate procedure for the labelling/qualification/certification of information;

– to be able to identify best practice and follow its example.

Standardisation work is already well advanced, but has yet to be finalised for:

– the neutral data formats that can be employed for the creation and use of digital models and on which software interoperability depends; the ISO 16739 standard on IFC needs to be completed, brought to Europe and promoted...
to software vendors and all the stakeholders concerned
– descriptive information about construction products: the NF P07-150 XP experimental standard, in the process of being published, should be brought to international attention and submitted to trials that will validate the possibility of deploying electronic catalogues suited to the needs of the sector. The digital model will have to be “fed” with the information essential to professionals, and in particular data on construction materials and products needs to be available in formats that are as standardised as possible and compatible with the various stages of projects; it must be possible to complete the digital model first of all generically and then more and more accurately with the characteristics of the building materials and products that will enable buildings to achieve the required performance levels.

POSSIBLE ACTIONS
The building world will need to move forward in terms of confidence with regard to all these new concepts and tools, and it will be important:
– to organise and support standardisation (NF, CE, ISO), in terms of both the data formats used in digital models and the information on materials, products and equipment that the model needs
– and in parallel to study the desirability and feasibility of a system of markers of trust suited to tools, stakeholders and projects, with the aim of gradually establishing the development of work in collaborative mode
– in particular, to establish certification for software tools, validating the full implementation of IFC (export and import) through specific tests and allowing construction industry players to invest with confidence

**Action 4.1. Monitoring standardisation work**
Organise, lead and support France’s representation (the interests of its construction sector) within the standardisation bodies at European (CEN) and international (ISO) level while ensuring the link between formats and standards for buildings with those for urban districts (CityGML, the INSPIRE initiative etc.). Specify subsets of the ISO 16739 (IFC) standard adapted to each phase of the project and, on this basis, develop a suitable certification procedure to ensure the quality of exchanges between different software tools and between different stakeholders using the digital model.
Like the work on “object libraries” in different countries, and in accordance with the work at the national level as part of the NF P07-150 XP experimental standard, make it easy to access information on components and construction systems from different manufacturers.

**Action 4.2. Certification system for software tools**
Establish a system of certification for software tools, validating the full implementation of IFC (export and import) through specific tests.

**Action 4.3. Advisability study on establishing a trusted operator**
Study the advisability of establishing a trusted provider for digital technology in construction, bringing together the relevant and interested stakeholders, whose role will be to provide an information qualification service to establish confidence and act as a catalyst in the development of digital tools.

**Action 4.4. Implementation guides and software**
Provide software vendors with implementation guides for digital models and promote the emergence of trusted French software based on the digital model, while supporting its international spread.

To support the deployment of digital tools on the scale of entire projects, new functions will probably emerge. These will aim to train, assist, coordinate and establish new rules of digital operation.

**Action 4.5. Study of emerging new features**
Study the emergence of new synthesis functions (BIM manager, doc controller etc.) and their relationship with existing functions. Avoid any opportunism effect and favour the enrichment of skills among players in the chain.
New means of expressing the regulatory arrangements should be tried in order to facilitate their application. In order to simplify procedures and the implementation of standards, digital tools can provide valuable assistance to designers by automatically selecting the technical and regulatory texts that apply to their project. An additional step could be taken with the automatic verification of the digital model’s compliance with certain constraints applying to buildings.

**Action 4.6. Constraint supervisor**

An experimental trial of a constraint supervisor could be conducted to study the feasibility of new formulations of technical and regulatory requirements, allowing for automated testing via a digital model.

**MAIN RESULTS**

ISO standard adopted by CEN describing data formats (IFC) for the constituent structures of the digital model, adapted for software interoperability.

Generic library of typical structures using these data formats.

NF and then CEN and/or ISO standard for generic descriptions of building materials, products and equipment.

Electronic catalogues published by manufacturers based on this standard.

Certification of BIM software.

Labelling/qualification/certification service for information exchanged.

Demonstration of the feasibility of a technical and regulatory constraint supervisor.
Conclusions and perspectives

Following large-scale consultation with representatives of all stakeholders, a common, shared desire is emerging to launch a general mobilisation on the subject of digital technology in the industry under the aegis of the state. A “digital transition” plan for the building industry (in its widest sense), supporting and supplementing the energy transition plan, is expected by all parties.

The implementation of the actions in this digital transition plan could be entrusted to a dedicated team (a “task force”) that will:

1. supervise the various measures to support the deployment of the plan;

2. provide high-quality reporting about the deployment of the plan to all the ministries concerned. This interministerial dimension is important, firstly in relation to the subject itself, which necessarily involves several different spheres of public intervention, and secondly to ensure consistency with the digital dimension of various ongoing initiatives (Nouvelle France Industrielle, the draft bill on the energy transition and green growth etc.).

A steering committee, gathering together the main professional parties involved and the public authorities, will need to provide guidance on the strategy and how it fits with social issues, the coordination of technical deployment and the socio-economic dimensions related to the transformation of the industry and ensure that the actions are undertaken.

Sector-specific groups composed of representatives of professional organisations will inform these different levels with their thoughts and specific needs: project owners, estate managers, project managers (architects, consultants, economists, technical inspectors, surveyors etc.), contractors, manufacturers, wholesalers, public-sector bodies (government, regional councils, local authorities etc.) and associated players: banking, insurance, management agents etc.

A particular group of software vendors should also be set up to ensure the emergence of a French software offering based on the digital model and support its international development.

Finally, a group will be required for the development of specific measures aimed at micro-businesses/SMEs. The digital transition plan must be part of a multi-year planning logic while highlighting several objectives possible in the short term, including 2015.
Conclusions and perspectives

Actions for 2015 may focus in particular on:

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<tr>
<td>Setting up a “digital building portal”</td>
<td>July 2015</td>
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<td>Analysing digital experiments in progress and assessing the benefits (cost, time, quality etc.)</td>
<td>July 2015</td>
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<td>Developing guides to implementation and the BIM protocol to launch the first projects under public ownership and provide support for the state as an example-setter in the construction and renovation of public buildings</td>
<td>End of 2015</td>
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<tr>
<td>Defining and launching a “digital quality” label for projects</td>
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<td>Establishing and operating a “National Network of Local Initiatives” for digital operations</td>
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<td>Organising an annual national competition for the most successful projects using digital tools</td>
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<td>Setting up a communication plan for digital tools (conferences, media events, exhibitions etc.)</td>
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<td>Launching the development of training suitable for use with MOOCs in construction, focusing on digital operations</td>
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<td>Finalising agreements with schools of engineering and architecture</td>
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<td>Identifying test beds for digital building permits</td>
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<td>Developing specifications for BIM kits for tradesmen and construction micro-businesses/SMEs</td>
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<td>Defining the content of the “digital monitoring and maintenance logbook for housing” specified in the Energy Transition for Green Growth act</td>
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<td>Defining the strategy on collaborative platforms for digital data management in the operations phase</td>
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<td>Organising and supporting French representation on the standardisation bodies dealing with digital operations at European (CEN) and international (ISO) level</td>
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<td>Defining the strategy for certifying software and stakeholders</td>
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<td>Testing the NF P07-150 XP standard for descriptions of construction products</td>
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<td>Defining an appropriate strategy for the promotion of French software based on the digital model</td>
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Appendices

Appendix 1

Letter of appointment
Face aux opportunités qu’offre le numérique pour le bâtiment et à la mobilisation des acteurs à porter eux-mêmes la modernisation du secteur, il est essentiel de structurer la démarche française pour évaluer les axes stratégiques du développement et accompagner cette révolution dans le bâtiment qui sera portée de croissance pour des secteurs dévengent de l’économie à très forte valeur ajoutée.

J’ai donc décidé de vous confier une mission visant une part à préciser l’état des lieux du savoir-faire français du numérique appliqué au bâtiment, ses forces et faiblesses, et définir d’autre part les axes stratégiques et opérationnels de développement à engager dans le but de permettre une généralisation du recours aux outils numériques par l’ensemble des acteurs dans le bâtiment à l’horizon de 2017. Cette mission s’inscrit dans la continuité des engagements de la démarche de concertation menée et se veut préciser dans le détail les actions hiérarchisées par une feuille de route opérationnelle à déployer aux côtés des professionnels du bâtiment. L’objectif est de faire de la finance un acteur référent du bâtiment numérique sur chacun des projets de construction et de rénovation, sur la scène européenne et internationale.

Vous appréciez votre analyse notamment sur les éléments en annexe résumant les réflexions issues des acteurs de la construction lors de la concertation.

L’entrée du bâtiment dans l’ère du numérique constitue un défi qu’il importe de relever collectivement et une opportunité sans précédent pour relever avec ambition le processus de construction, les opportunités entre les acteurs et les leviers pour plus de qualité à moindre coût.

Le succès de cette mission reposera essentiellement sur l’exigence qu’il nous faut déployer à fidéliser les initiatives, capitaliser l’innovation et créer les conditions d’un bâtiment numérique pour tous.

Vous pouvez, pour la conduite de cette mission, vous appuyer sur les services de la direction de l’habitat, de l’automatisme et des paysages et recevront un rapport d’étape pour le 20 octobre. Votre rapport définitif sera présenté pour le 15 décembre.

Jo vous peu d’agir. Mansieur, l’expression de mes sentiments distingués.

Sylvie PINEL

Sylvie PINEL
## Appendix 2

### List of contributions published online

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### Appendix 3

**List of participants at the plenary meeting of 30/09/14**

<table>
<thead>
<tr>
<th>Name</th>
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<tbody>
<tr>
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