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Nikkei BP Consulting, Inc.

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BIM Usage Survey Report

2011 (surveyed in 2010)



(CG:Konoike Construction Co. Ltd.)

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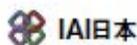
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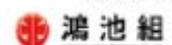
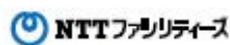
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Preface

The technique "BIM (Building Information Modeling)", which is a method to design buildings with a virtual building on the computer combining the design information database with 3D model in the computer, begun to be told in the construction industry in Japan around 2007.

"KEN-Platz" website of Nikkei Business Publications, Inc., specialized in AEC industries has been paying attention to the potential of BIM since then. Staff of the website has been attending the American Institute of Architects' (AIA) National Conventions every year since 2007 and reported about BIM usage in United States on several special sites.

KEN-Platz reported special series article the "BIM Bootcamp", in which beginner attendee mastered BIM in a half year by monthly training, and held a seminar to enhance the productivity of the construction industry of Japan by BIM were held in 2008. It has been offering information on domestic and foreign BIM use to architects, engineers, and managers in Japan.

Finally, the number of companies that introduced BIM increased rapidly in 2009, and it was said that 2009 was the "first BIM year" of Japan". The BIM use level of Japan is catching up rapidly at the world level so that virtual BIM competitions called "Build Live Tokyo" (Japanese version of the "BIMStorm") were held on the Internet by IAI Japan in which attendees design the building on the subject in 48 hours.

Does this "BIM boom" end temporally? or BIM will keep spreading in the future, and be accepted as a strategic tool that achieves the productivity enhancement of the construction industry?

In order to find the answer, KEN-Platz and Nikkei BP consulting, Inc. conducted the "BIM Survey" on the Internet from September to October, 2010 for practitioners in Japanese AEC industries. The results show that BIM had already been introduced in one third of the companies where the respondents worked for, and two thirds of the companies were enjoying the effects of business improvement. And, the more than half of respondents whose office did not use BIM answered that BIM would become more important in five years. It is thought that BIM would be gaining popularity in the future as not only a tool for CG but also a tool to achieve the productivity enhancement of the construction industry.

Many people cooperated to publish this survey report. We sincerely want to express our

thanks to 517 respondents to the survey. The Japan Institute of Architects, the Architectural Institute of Japan, IAI Japan, BIM software vendors and their user's groups helped us by announcing about the survey to their members. The Ministry of Land, Infrastructure and Transport and many companies presented the newest BIM usage cases to us. It was owing to Autodesk, Inc., the special sponsor, that we could publish the results of the survey as a report, and open it to the public.

We sincerely hope this BIM survey report would help to expand BIM use in Japan, and the productivity enhancement of AEC industries.

February 1st, 2011

Nikkei BP consulting. Inc./KEN-Platz

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Introduction

BIM Supports Construction Industry's New Growth

Beginning to be seriously used in the Japanese construction industry, BIM (Building Information Modeling) is now in the spot light.

The “KEN-Platz” (<http://www.kenplatz.nikkeibp.co.jp>), the largest AEC website run by Nikkei Business Publications, Inc., and the Nikkei BP Consulting jointly conducted a BIM usage survey targeting construction practitioners in Japan, between September and October 2010. 517 responses gave their answers.

The result from both an analysis of website survey and on-the-ground research from construction practitioners, rapid increase of using BIM produces productivity gain in design and construction, provides a new service by visualization of design and expanding international business using its communicability.

Over 70 % BIM Adopters See Improvement in Business

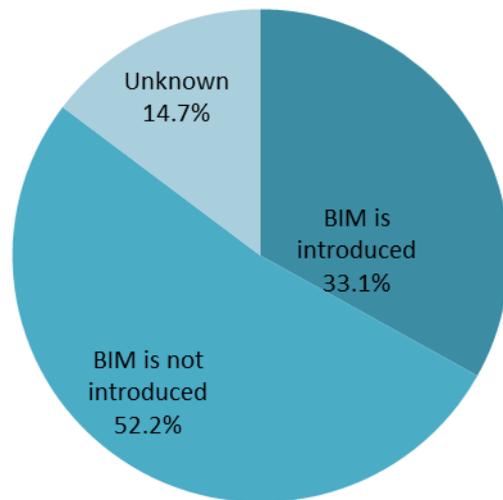
In the construction industry, there have previously been several “3D boom”. However, due to the software being difficult to use or hardware being too expensive, BIM has not taken hold. Further, free 2DCAD software is widely used.

On top of these background issues, it remains unclear whether BIM is worthwhile to introduce despite its expensive cost. BIM requires an investment of several hundreds of thousands of yen in 3D software. Thus, it is quite understandable that there are many practitioners and proprietors hesitate to introduce.

However, the results of this survey show that among 171 respondents adopting BIM in their workplace, 71.9 percent claims there is a business improvement effect. Further, 25.7 percent responded that productivity has increased over 25 percent.

In short, BIM can be seen as a tool capable of sufficiently increasing efficiency upon adoption. “3D booms” in the past was the little more than a production of computer graphics (CG), but BIM's function is multifaceted.

Introduction of BIM in Office(N=517)



From CG Creation Tool to Efficiency Improving Tool

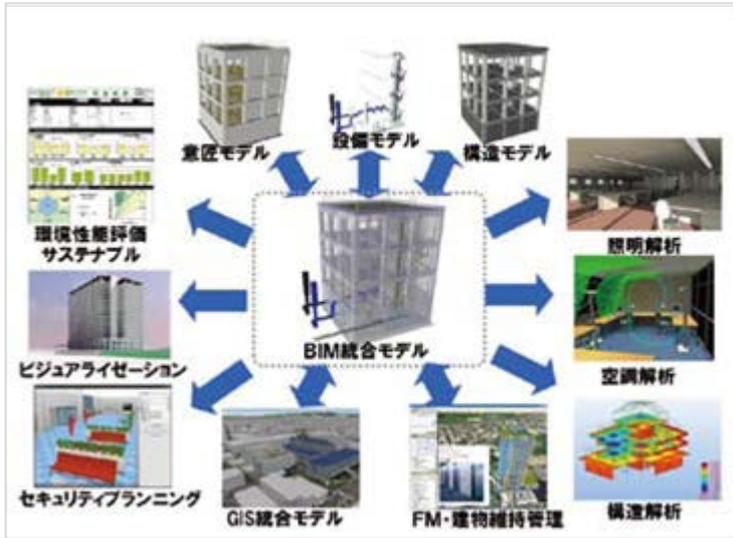
Konoike Construction Company has been using a 3DCAD that supports BIM for nearly ten years. The motivation for its first introduction was quick production of CG, but the company created BIM promotion department in 2009.

Following their three-year plan, they are proceeding to introduce BIM company-wide in their office in Tokyo, Osaka, Nagoya and Fukuoka. Initially, the targeting user is architecture designer but will be widen to structure and facility practitioners.

In the 2012 fiscal year, the company will have a BIM design and construction project at a time in Tokyo and Osaka.

Yasui Architects and Engineers introduced BIM company-wide in 2007. BIM is applied not only for designing inspection and plan creation in architecture design process, but also for checking materials, structure analysis and thermo-fluid simulation.

Moreover, while seeking to introduce BIM into construction and maintenance phases, they are searching to provide new services.



BIM (Building Information Modeling) is the method creating Building's virtual 3D model to carry on the design process all together.



Konoike Construction has BIM Department for implementation of BIM



CG perspective image using BIM (Data from Yasui Architects and Engineers)

MLIT is also Beginning a Trial of BIM

Given the increase use of BIM and its good results, the Government Building Department of Ministry of Land, Infrastructure, Transport and Tourism (MLIT) began a trial project in the 2010 fiscal year, following “The Implementation of Using 3D Data” provision in “MLIT CALS/EC Action Program 2008” which was announced in March 2009.

MLIT’s Kanto Regional Development Bureau had a public proposal obligating to use BIM for the New Shinjuku General Labor Department Building. As a result, Azusa Sekkei was selected as a designer.



Plan-making subcommittee of “MLIT CALS/EC Action Program2008”

BIM Realizes Productivity Enhancement in Construction Industry

Although the increased use of computer and CAD, design and construction methods in the industry have not fundamentally changed in the last decades. As a result, the construction industry's productivity which was relatively high among industries twenty years ago has continued to decrease and currently has a significant difference, compared to manufacturers, for instance.

However, with the spread of BIM in the construction industry a front-loading effect can be realized that will solve the design problems in advance. The productivity of design and construction can increase, and additionally gives new growth strategy such as maintenance management and overseas projects.

As the future of construction, how is BIM is being used in Japan, and how will BIM spread in the near future? This report will present the current application of BIM in the Japanese construction industry, based on survey results and investigation of BIM adopting enterprises.

Adoption of BIM / Recognition of BIM

80% of Respondents Recognized BIM

More than 30% Understand It's "Competitiveness of Company"

In the survey, about 80 percent of respondents recognized the word "BIM", and about half of respondents stated that they know what BIM means. This survey shows growing recognition of BIM in Japan. More than 30 percent of respondents take operating skills for BIM as corporate competitive power. It could be said that BIM is not just only tool for designers, but also BIM entered next phase as a success factor for architecture business in the coming years.

About 80 % Respondents Recognized BIM

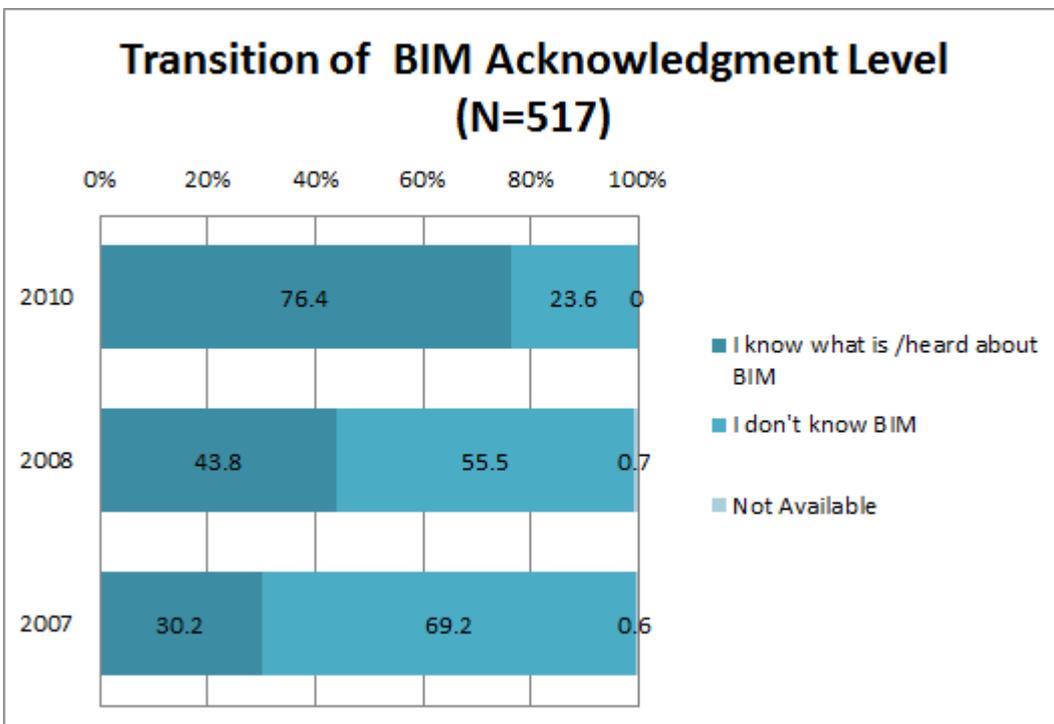
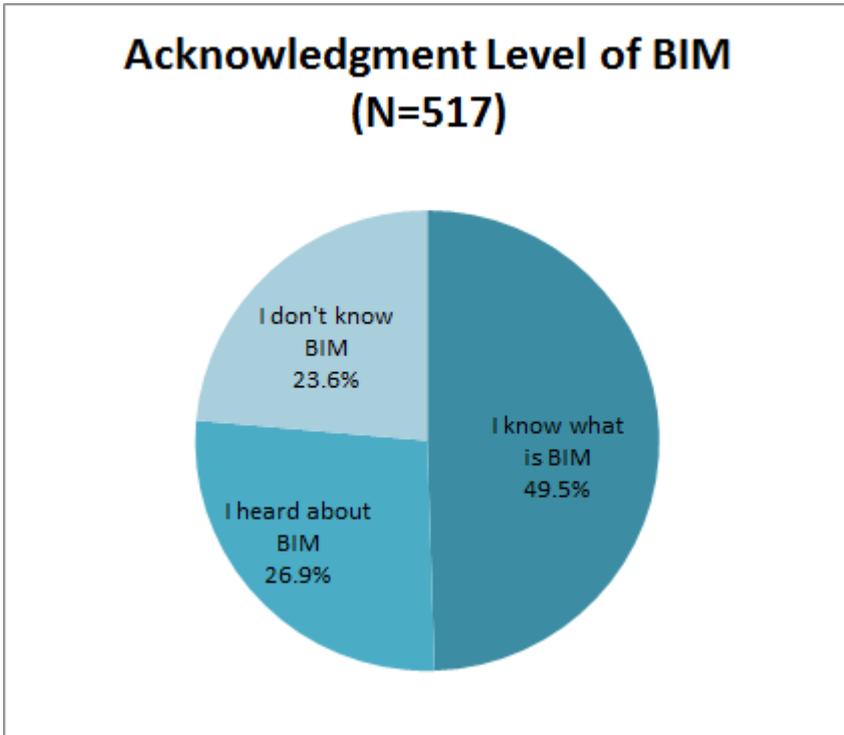
This survey conducted on practitioners who work at architecture offices, construction companies or related industries. Out of 517 respondents, when asked that you know the word "BIM" (Building Information Modeling), the percentage of respondents who said they know reached 49.5. The respondents answer they have heard the name totaled 26.9 percent. All together, the survey clearly shows that 76.4 percent recognized the word "BIM".

In recent years, the word "BIM" frequently appears in articles or ads in the Internet or magazines. Architecture organizations, software vendors and the media are actively trying to educate and encourage using BIM.

Furthermore, in 2009, the Internet virtual competition using BIM to design the building in 48 hours called "Build Live Tokyo" (Organized by IAI JAPAN) was planned and implemented by Japanese people. Architect's offices, construction companies, software vendors and universities joined the competition and proved advanced productivity of BIM. The competition was live streamed onto the Internet and many audiences experienced the BIM power.

KEN-Platz surveyed about BIM in questionnaires about utilization of 3DCAD on its own web site both in 2007 and 2008. In the survey, 30.2 percent of respondents in 2007 and 43.8 percent of respondents in 2008 answered that they know or heard the word BIM before, and it was below the half. This data supports that BIM rapidly gain its recognition

in the two years.



About 30% Perceive BIM as Competitiveness

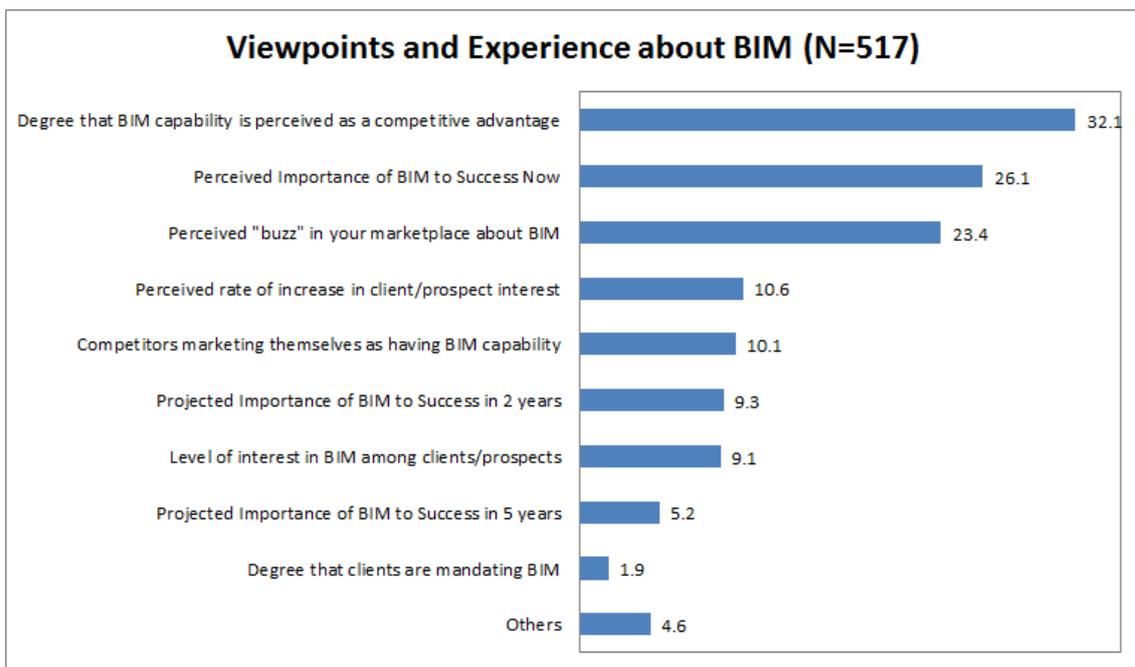
Asked perception and experiences about BIM, 32.1 percent respondents which is the

highest answer BIM operation skill is the corporate competitiveness.

The respondents think that now BIM is the critical factor for success in business totaled 26.9 percent. Seeing the responses on related questions, when asked BIM is the critical factor in order to success in business from 5 years ago was only 5.2 percent, and from 2 years ago was just 9.3 percent.

This means that BIM is recently understand more for mission critical system impact on company's operation than just CG creation or drawing tool.

The respondents who see and hear a BIM boom reached 23.4 percent which is a quarter of the total. BIM is recognized as a boom in the construction industries. Furthermore, 10.6 percent feels clients or future client growing interests about BIM, 10.1 percent answers that competitor use BIM for advertising, and 9.1 percent answer that clients or future clients interested in BIM. This states that about 10 percent of the respondents actually feel the growing interest of BIM from their business experiences.



Controversial Views from Free Answers

There is a variety of pros and cons on BIM in the survey's free answers. "BIM is critical in the future", "BIM's view is useful in architecture design", "BIM system is beneficial in this coming 50 years", "correspond with globalization", and "easier to promote environmental sustainability" are opinions that look at BIM as construction industry's benefits in the

future.

In contrast, “not necessary”, “It is not worth putting the costs on its implementation”, “A little demands of its usage in the current situation”, “BIM is good system but nonessentials for small offices”, “Manipulated by software vendors” are negative opinions that does not feel the necessity of using BIM in their work.

Adoption of BIM / Year and Reason of Adoption

30 % has Already Introduced BIM in the Office

Aiming to Improve Business and Workflow

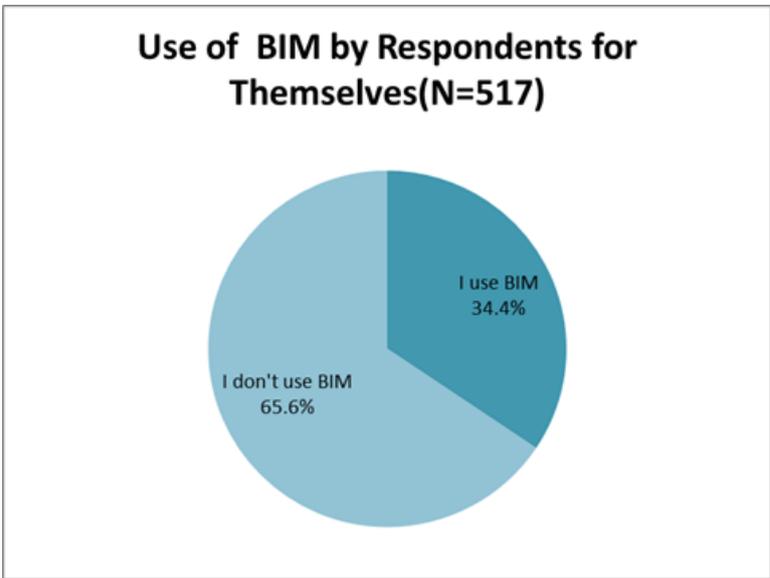
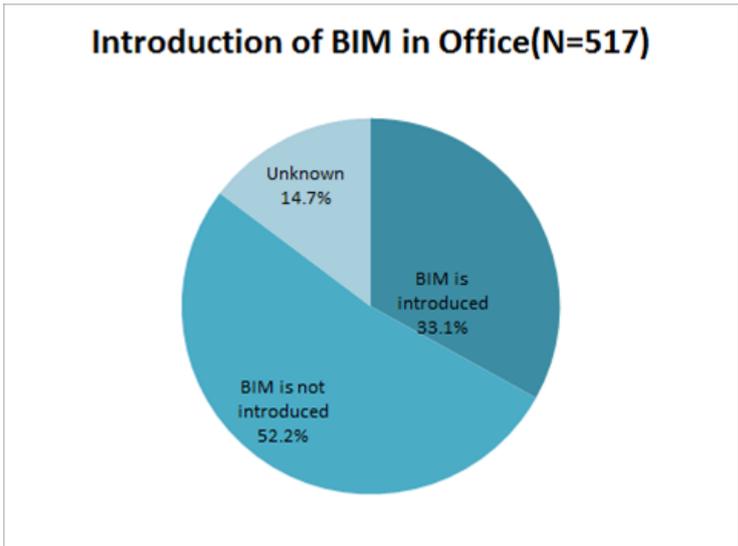
The survey shows respondents who answer that their companies introduced BIM account for a one third and more than the half introduced BIM in or after 2008. Efficiency and improvement of the workflow are the top reasons why introduced BIM. It can be said the number of the company introducing BIM has been increased not for a tool to create CG or perspective image, but for the productivity enhancement tool.

30% of the Companies has Introduced BIM

33.1 percent of all the 517 respondents answered that their companies introduced BIM. Seeing the number by the product life-cycle point of view, it can be said that the BIM's introductory period which is the first software installation phase with the least demands, has been passed and entered into pre-growth period in architecture industry.

The number of architecture CAD software supporting BIM has increased in recent years. Widespread use of BIM is seen not only in big companies, but also in small to medium size companies. In addition, the region using BIM increased suburban areas as well as areas around Tokyo.

With these circumstances and one third of the respondents' company introduced BIM, it is expected to continue its increasing use. 34.4 percent of the respondents use BIM by themselves when asked.



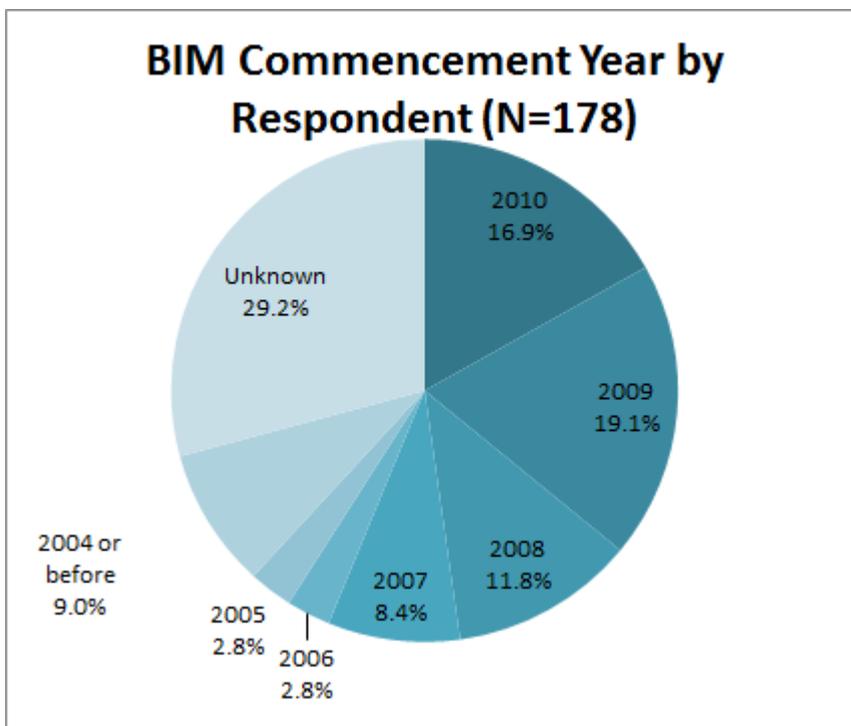
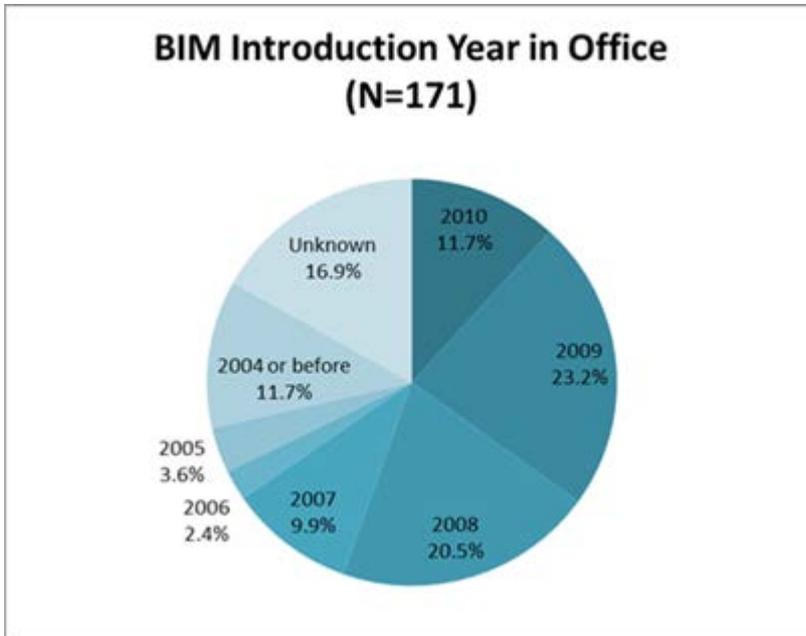
BIM was Mostly Introduced in 2009

The 171 respondents who use BIM at their companies are asked when they introduced BIM, and bulk of the companies introduced BIM after 2008. In particular, the highest number introduced is in the year 2009 (23.4%), then the second highest is 2008(20.5%), and 2010 (11.6%) follows.

It is often said that the year 2009 as the “first year of BIM in Japan” and it is also supported by this survey result for three years around the year is the highest number introduced BIM.

Meanwhile, 20 percent of the company introduced BIM before 2006. It is the time before

BIM is recognized in Japan. It shows that at the time, quite a lot of companies sees the benefits of the 3DCAD, and use to create 3D models, CG and perspective images, practically used same as BIM.



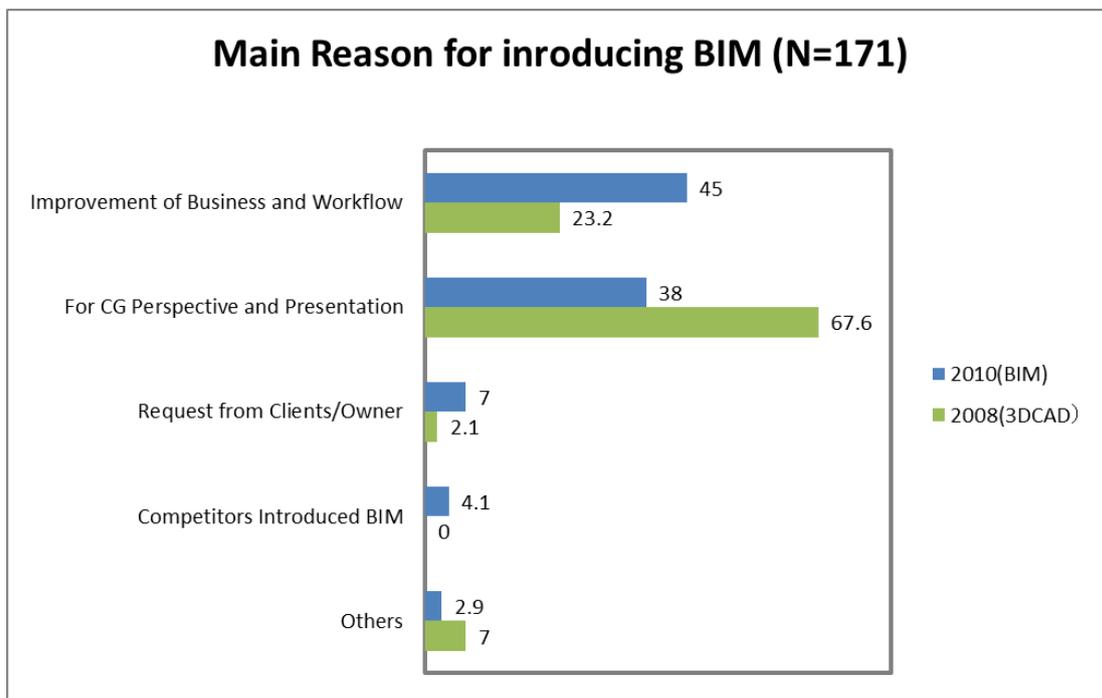
Reason of Introducing BIM has Changed

The 171 respondents who use BIM at their companies are also asked the most important reason why introducing BIM at their companies. The result shows that efficiency and improvement of the workflow account 45 percent which is the highest response, and surpasses presentation purpose such as creating CG or perspective images by number (38%).

KEN-Platz surveyed in 2008, hence asked the reason of introducing 3DCAD instead of “BIM” due to the word was not popularly used at the time, 67.6 percent responded for presentation purpose such as CG or perspective image creation, which was the vast majority at the time.

This distinctive change of response shows the characteristics of BIM. While 3DCAD is perceived as a tool to create CG and perspective images, BIM is recognized more for a tool to realized efficiency and improvement of the workflow.

There are also other responses for the reason why using BIM. For example, 7 percent respond the demands from clients (2.1% in 2008), and competitor introduced BIM account 4.1 percent (0% in 2008). Business and external environment changes are the reasons. The result shows that some cases have to introduce BIM due to the business with clients and external business environment change.



Adoption of BIM / Obstacles for Adoption

Cost of Software is the Most Obstacle to Introduce BIM

Half of Non-Users Understand the Importance of BIM

Bulk of the respondent perceives that BIM will become more important over the next five years, even respondents whose companies are not adopted BIM yet. Despite this, the largest obstacle to introduce BIM is its expensive cost of the software. The respondents think that reduced price is the key to introducing BIM in the future reached 40 percent. Meanwhile, 15.6 percent respondents feel no need to change way of work, thus introducing BIM is unnecessary.

Largest Obstacle is the High Price

Asking question to the 270 respondents whose companies have not introduced BIM yet, what is the obstacle of its introduction. The high cost of the software was the top reason that accounts 46.7 percent.

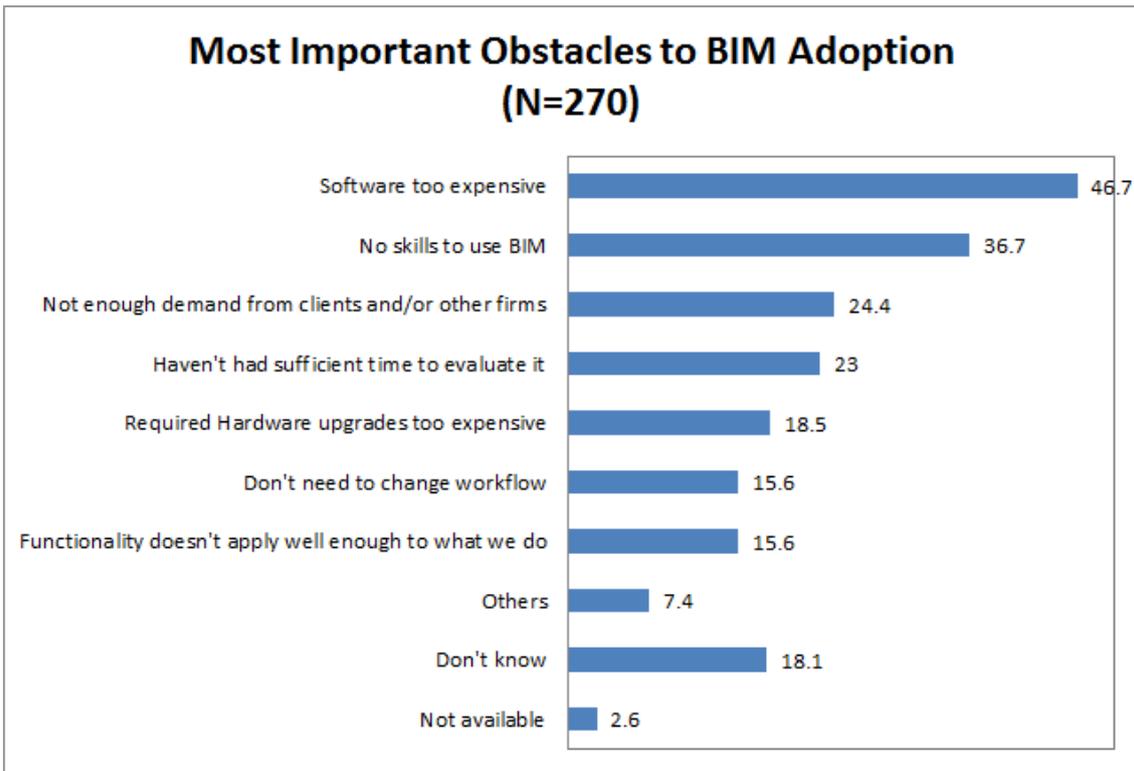
It is also shown in the survey KEN-Platz has done in the past that the top reason not introducing 3DCAD was its high cost. The reason reached 66 percent in the year 2006 and 56 percent in the 2008.

However, the data shows the decrease in number of respondents who put off introducing BIM (or 3DCAD) because of cost year by year.

Additionally, 36.7 percent responded bring the reason of not adopting BIM is that they do not have skills to good use of BIM. It was the second top reason in both year 2007, and 2008. Many users still have a wide berth to use BIM due to its difficulties.

On top of these reasons, no strong demands from clients or other companies (24.4%) and unclear benefits (23%) are also reasons for not adopting BIM.

15.6% respondents say that they feel no necessity of introducing, and company's work does not correspond with BIM. Thus, some respondents feel there is no need to use BIM for their workplace.

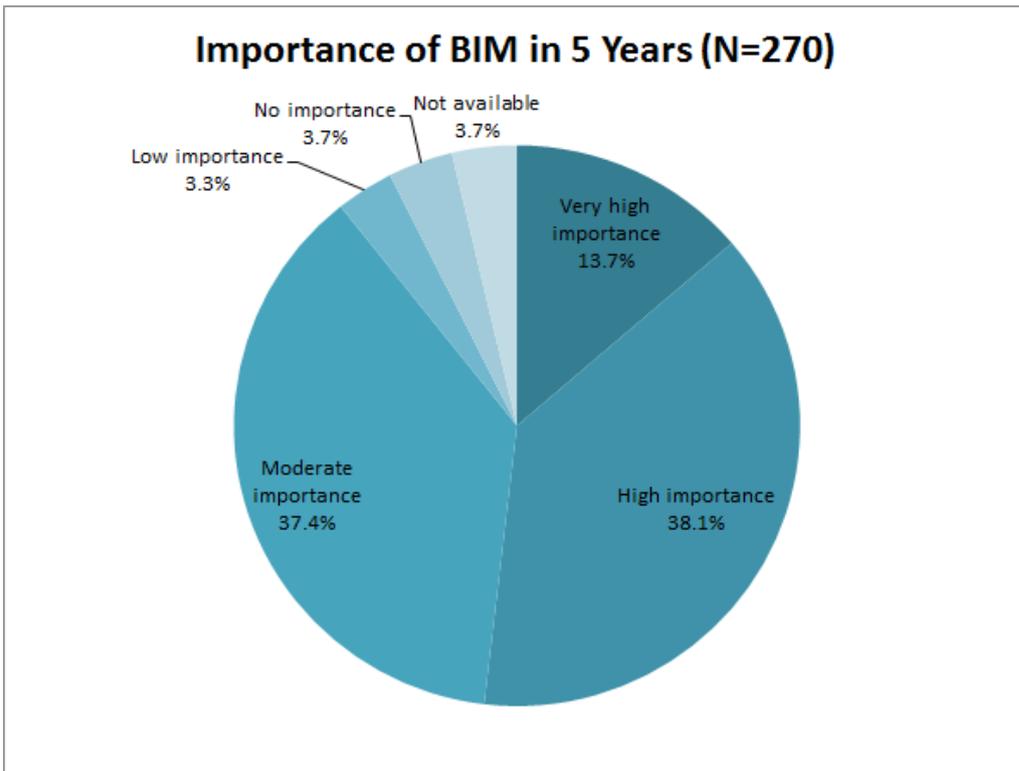


Over 50 % Perceive BIM is Important, Including Non BIM Users

Asking questions that whether BIM will become critical tool or not in the next five years to respondents whose workplace has not introduced BIM yet.

Combining 13.7 percent of respondent who think BIM is very important and 38.1 percent of whom says it is important, the total number reached 51.8 percent. In contrast, the number was less than 7 percent total who responded BIM is not very important (3.7%) and not important (3.3%).

Seeing the result, many respondents, even non BIM adopting practitioners, think BIM will become important tool in the near future. Moreover, if there are chances it is highly possible that they will move toward to introduce BIM. What will be the critical motivation?



Reduced Software and Hardware Price Leads Introduction of BIM

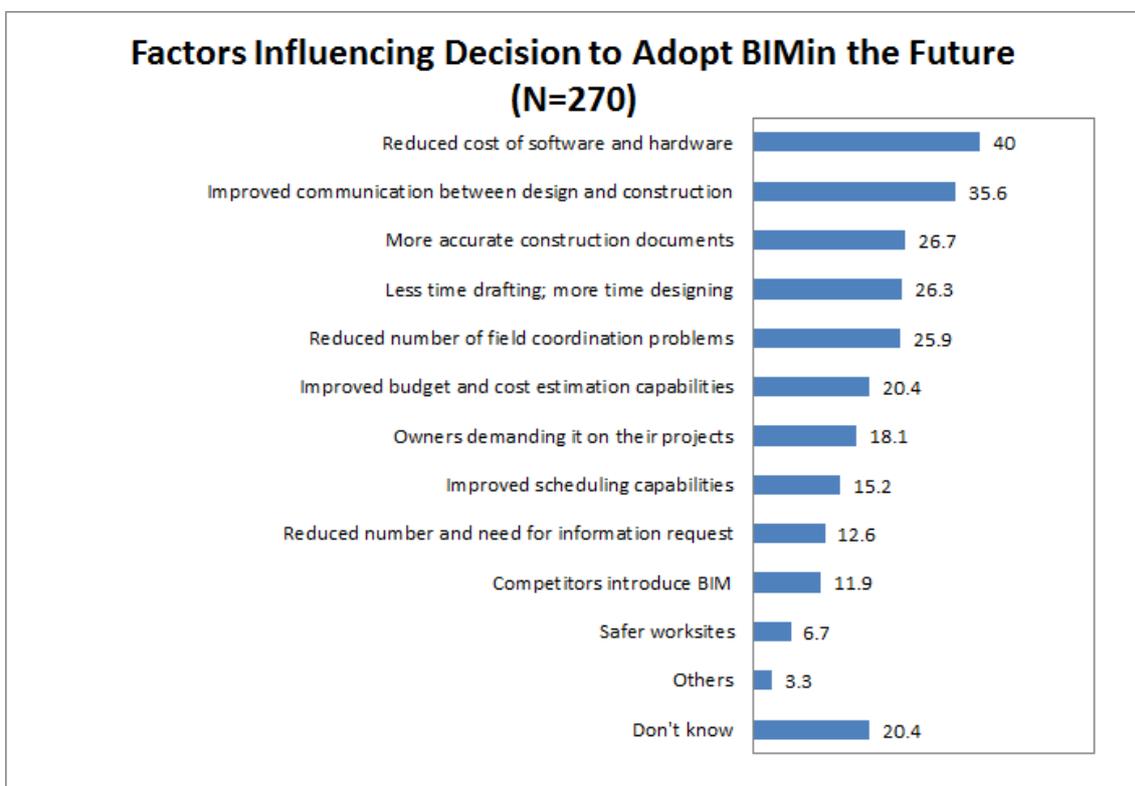
The survey asked respondents whose companies have not adopted BIM yet, what will be the reason to introduce BIM in the future. As a result, the reduction of software and hardware price reached 40 percent of the respondents and it was the top reason.

Major BIM software costs from seven to eight hundred thousand yen in price, while 2DCAD software costs about ten hundred thousand yen or even free software such as Jw_cad. To some practitioners who perceive CAD as free software, it is understandable that BIM is highly expensive tool to introduce.

35.6 percent was the next top reason of possibilities of introducing BIM is that if the respondents can see the better communication between design and construction. By using 2DCAD, most of the time is taken to the meeting and convey the tremendous amount of information. Even users move a lot to communicate and understand the design information. However, BIM is possible to work as communication improving tool that reduce the workload and time devoted for communication. Many people think that is also the reason of future introduction of BIM.

Another reason of adopting BIM is such as possibility of production of better construction documents (26.7%), less time for producing drawings and more time for designing (26.3%), reduce problem solving at construction site (25.9%), improved budget plan and cost prediction (20.4%). Design quality, efficiency of time, and reducing the risk with clarity of budget and cost are the major reason of possibility introducing BIM.

Additionally, there are some respondents who think external environment needs is the possible reason of introducing BIM, such as owners asked to use BIM (18.1%), and competitors introduced BIM (11.9%).



Case Study 1: BIM for The Owner

MLIT starts a trial project of BIM

Department of Ministry of Land, Infrastructure, Transport and Tourism (MLIT) & Azusa Sekkei Co., Ltd.

Department of Ministry of Land, Infrastructure, Transport and Tourism (MLIT) had been paying attention to the merits of using BIM as an owner. MLIT started a trial project of BIM for the Government Building in 2010 fiscal year. Design Project for New Shinjuku General Labor Department Building is chosen as the first trial BIM project. After making contract with Azusa Sekkei Co., Ltd in October 2010, front-loading effect has been already seen for two month. MLIT also uses BIM for other project such as New Japan Coast Guard Department Building and Private Finance Initiative (PFI) projects.

MLIT Tests BIM Project as Part of CALS/EC

Department of Ministry of Land, Infrastructure, Transport and Tourism (MLIT) formulated “Construction CALS Development Master Plan” in 1996 fiscal year aiming to improve efficiency while sharing information and cooperation of public project. After the formulation, based on the action program, MLIT rapidly applied IT system for public construction projects such as electronic bidding system, and reception of CAD data as drawings.

“We have started preparation in 2008 fiscal year. To make a timely introduction of BIM, we decided to start test project by seeing current widespread use of BIM “says Yoshida Hiroshi, Director Building Assessment of Facilities Division Government Building Department of MLIT.

In March 2010, Government Building Department of MLIT officially announced to start trial BIM project. They held open proposal of New Shinjuku General Labor Department Building on June, 22nd. They asked to submit a technical proposal document obligating to use BIM models.

The result was presented on September, 15th. Azusa Sekkei Co., Ltd. was chosen as a designer. On October, Azusa Sekkei contracts with MLIT. They have been working on the project and producing schematic design, detail design, and estimates by using BIM. They

will submit drawings and BIM data by the delivery time, on March 2011.

MLIT Pays Attention to the BIM's Merits

Government Building Department of MLIT is expecting that BIM can realize the elimination of cost, maintaining the quality, and improving user sufficiency of their buildings by introducing BIM from design to construction process as a whole.

They are expecting three major merits as follows, 1) visualization of design 2) entering building information and checking data compatibility 3) integrating and unification of building information. They also point out the detail effect of each merit.

From the 1), improvement of transparency and interpretation can be expected that will support the rapid decision making between the people involving the projects. From the 2), design meeting with standard performance of government buildings requirements can be realized efficiently and effectively. From the 3), through a design and construction, developing building information model to use for facility management (maintenance management) of government building, and management and maintenance of building by building manager.

New Shinjuku General Labor Department Building with 1st story basement floor and 5th stories floor has about 2,800 square meters of total floor area. Azusa Sekkei started schematic design by using BIM supporting software. The effort is already shown in November.



Image perspectives of New Japan Coast Guard Department Building(left) and complex of Japan Meteorological Agency's Toranomom Office(tentative name) and Minato-ku Education Center

Building(right)

Considering View of the Building from Train

“Because design idea comes every week from the designer, the operating speed is quite high. BIM is easier to understand the design problems. And, I am experiencing the front-loading effect.” says Yasuhiro Tonosaki, Director of Maintenance Group of Facilities Division, Government Building Department of MLIT (GBD).

Due to the government building which many people use, they consider how façade design of new building can be seen from other buildings, and how the surrounding building can be seen from inside by using BIM. The building is also near the Yamanote train line. They also consider how the building can be seen from the running train.

“Such a consideration is impossible with conventional method. Structure design is also done by BIM model. It is much faster to consider the location and sizes of openings.” says Jun Saiki, Chief of Maintenance Group of Facilities Division, Government Building Department of MLIT (GBD).

Azusa Sekkei’s designers often bring lap-top computer to the GBD for presenting the design using BIM. Moreover, they also use the software to see the walk-through images of 3D model buildings. Maintenance Group of GBD also uses the software to check the design by viewing the walk-through images.

Simulating Day-light, Wind Flow, Energy Environment

Azusa Sekkei, the designer, has introduced and utilized BIM supporting software 5 year ago. Every Tuesday and Thursday, they have a small lecture for three staff to educate BIM to increase BIM knowledgeable users in the company. Currently, the company has two kind of BIM supporting CAD software which they have about 100 licenses.

“New Shinjuku General Labor Department Building, we use variety of simulation software to simulate such as landscape, daylight, wind flow, and energy environment. We are also using BIM to consider facility design, structure design, and also to analyze structure.” says Yoshihiko Yasuno, Executive Director and Director of Design Group of Azusa Sekkei.

The company takes this project not only seeing how the design method and process changes by using BIM instead of conventional one, but also analyzing the effect of using

BIM in the company.

MLIT Seeks to Use BIM for Construction and Maintenance Phase

GBD also uses BIM for under construction project, New Japan Coast Guard Department Building Project (tentative name) at Koto-ku, Tokyo. The contractor of the project, Toa Corporation considers making general drawings which integrate architecture design, structure and facility drawings together, and construction drawings from BIM data received from the designer, Yasui Architects & Engineers. The main purpose of its use is to check arrangement and interference of duct, and to counting the quantity of steels and concretes.

The complex building project of New Japan Meteorological Agency (tentative name) and Education Center of Minato-ku applies one of the PFI method called BTO (Build Transfer Operate) method that public sectors build the government building by their own funds, and transfer the property to the government, and manage the operation and maintenance. The contractor of the project, Taisei Corporation proposes using BIM for operation and maintenance management.

It is often said that the life cycle cost of a building is a much larger at operation phase than construction phase. The most merits of a client introducing BIM is the reduction of total building cost of a building by applying BIM throughout a project management from design and construction to operation and maintenance all together.

MLIT have start using BIM is expected to boost up the widespread of BIM in construction industry.



Office of Azusa Sekkei which designs New Shinjuku General Labor Department Building(photo: Courtesy of Ryota Ieiri)

Utilization of BIM / Works Done by BIM

BIM Usage is Overwhelming at Architect's Works

Use in Structural and MEP Design Rapidly Increasing

From this survey, a majority uses BIM for architecture design and brainstorming of the project at its early stage. In contrast, less than 30 percent uses BIM for detail design, structural design, and MEP design. However, use of BIM for checking design and application documents, and simulating construction process is rapidly increasing.

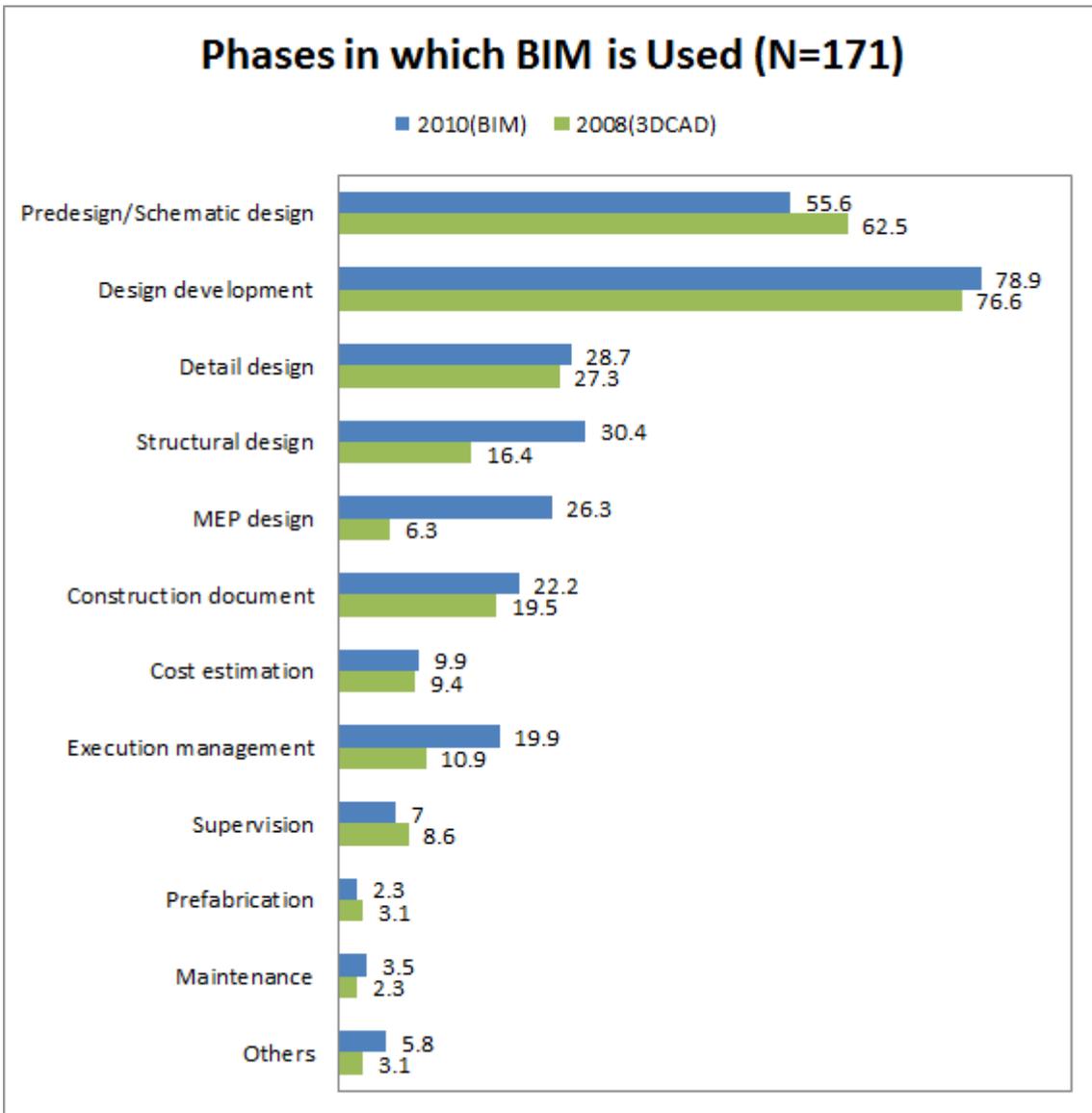
About 80% of Respondents Use BIM for Architect's Design Process

The 171 respondents whose company uses BIM were asked the question that in which work they used BIM. The most answered that they use BIM for design development and it is 78.9 percent respondents. The 55.6 percent uses BIM for the predesign and the schematic design and it is the second most responses.

This trend is same as the survey about 3DCAD usage in 2008. The result shows the majority of usage is still for design development process which is the very early phase of an architecture project. Some responded that they use BIM for detail designing still remains 28.7 percent and the result is same as the survey in 2008.

The number who responded that they use BIM for structural design (30.4%) and MEP design (26.3%) increased comparing with the survey done in 2008. Each usage rate is less than design development. However, in 2008 each rate was 16.4% for structural design and 6.4% for MEP design. Considering the number increase for two years, it can be said that BIM use in other design phases rapidly increasing.

Addition to these results, noteworthy is its use in the execution management phase. Comparing the survey, the use of BIM for execution management was 10.9 percent in 2008 and 19.9 percent in this survey, almost doubled the number increased. This result explains that BIM is started to be used more in the later phase of the project such as construction.



Increase Use in the Construction Phase

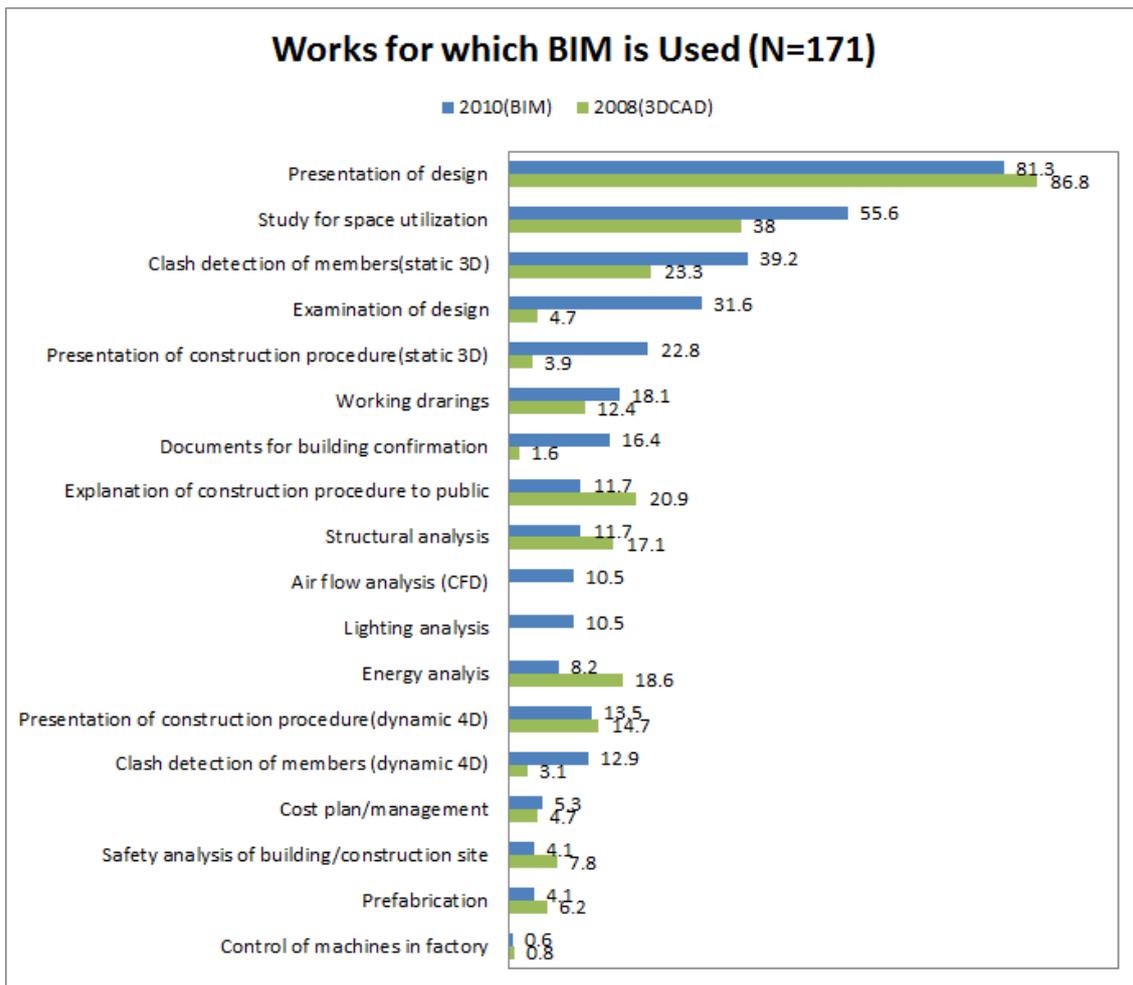
To understand the BIM use in detail, questions were asked to the 171 respondents whose workplace has introduced BIM how they use BIM.

81.3 percent of respondents answered that they use BIM for presentation of design. The next most response is for the study of space utilization and the number was 55.6 percent. The result shows the BIM user takes the advantage of BIM which strength is the visualization of 3D design contents and easiness for representing the space.

The other responses are checking the interference of members with static 3D data that is the third, 32.2 percent, and checking the design data is 31.6 percent, and for

presentation of construction procedure with static 3D data is 22.8 percent. Those are used in between the designing phase to construction phase. Comparing with the survey in 2008, all the number is increased.

Moreover, responses that making working drawings (18.1%), clash detection of the members with 4D motion data (12.9%) were also increased. These responses are more direct use of BIM for execution management.



Building Certification and Front-loading

In general, the most of the works have been carried out with vague detail structures or designs which were solved at construction phase or design changes when construction already had started. However, using BIM to connect design and construction phase will solve these problems. It is possible to solve the design problems in advance using the “front-loading” effect, one of the characteristics of BIM.

Because building certification assessment was tightened a couple years ago by government, it became more difficult to change the design after submission of application. Construction companies may want to reduce the total construction cost by preventing the design changes. It would be their motivation of introducing BIM at the construction phase.

Moreover, there are responses introducing BIM for variety of simulation purposes such as structural analysis (11.7%), air-flow analysis and CFD (10.5%), lighting analysis (10.5%), and energy simulation (8.2%). 10 percent of respondents workplace using simulation software. Software that provides IFC data file which enable to exchange BIM data with other software is increasing. The result also shows the current situation.

Utilization of BIM / Level of Utilization

Use of Property Information, BIM's Potential

BIM Use in Projects Increasing

The use of property information of BIM model is increasing for variety of purpose such as the production of perspective and images, drawings and door schedule, cost estimates and simulation analysis. It explains the user trend to take advantage of BIM model data as a database and apply for improvement of work in many aspects. Currently, the bulk of the companies apply BIM less than 15 percent of all of their projects. However, in the next two years, the more than half responded they will apply BIM for 30 percent of all the projects they have.

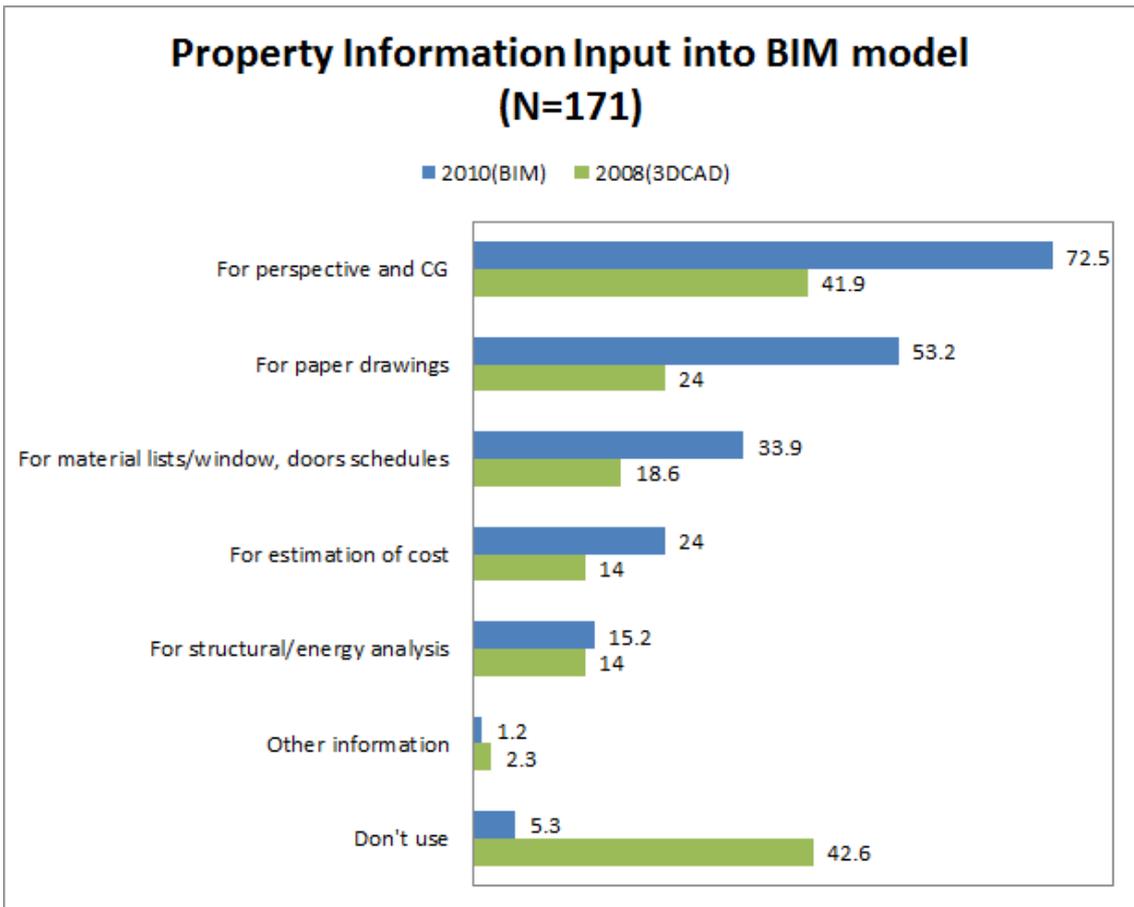
More Companies Use Property Information

BIM is often explained as combination of “3D representation of building” and “Database for building information”.

The database means the property information. For example, the color, texture, vender, model number and adiabaticity of 3D building information of a door and a sash are the property information data. Inputting those data into the BIM modeling, it enables to use BIM as variety of work phase and improve the efficiency of design works.

The 171 respondents whose company introduced BIM were asked about the input data of property information. As a result, almost everyone is using property information for their work. Comparing with the 3DCAD survey in 2008, there are increased users who utilize property information.

72.5 percent, the most of the respondents use property information needed for production of perspective and CG. It was 41.9 percent in 2008. It clearly depicts the not only using default data such as color and texture ready installed in BIM, but the user also input additional detail data to create better quality of perspective images and CG.



Doubled the Use of Property Information for Paper Drawings

The responded also says that putting the information needed for paper-based drawings is 53.2 percent. It was 24 percent in 2008. The number is doubled.

Slicing 3D BIM models to make 2D CAD drawings can not automatically produce an architecture drawing data usable in Japanese architecture industry style. It needs to be added or edited to make the drawings usable with each design phase such as schematic drawing and detail drawing that should be corresponded with appropriate scale and information. For example, the BIM models of the columns and walls are needed to show different details by different scale so that they look like “real” drawings.

BIM adopted design firms and construction companies created original BIM template based on their companies drawing sheet style. One of the BIM user group, Revit User Group Japan (RUG) also provides the drawing guide line aiming to be industry standard.

There is also increase number of use of property information for production of building

application documents from BIM models.

Moreover, the respondents who use property information for material list and window, door schedule is 33.9 percent and who use for cost estimation is 24 percent. Analysis of structural and energy analysis is reached 15.2 percent. These results depict the current company's attitude using BIM model to avoid duplicate data input and to improve the efficiency of design work.

Increase Use in the Projects

There are big differences among the companies applying BIM applied project rate.

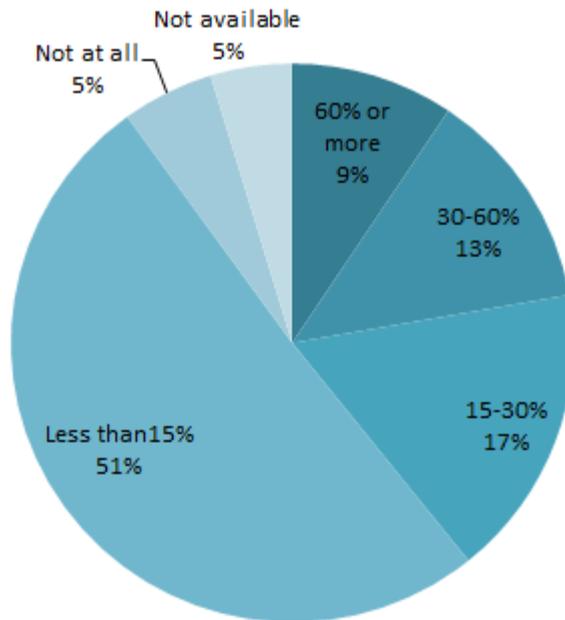
Asking question about the percentage of applying BIM for projects in their company, the respondents who use BIM less than 15 percent of all their projects reached 50.9 percent. Not using BIM at all reached 5.3 percent. It is 60 percent of all the respondents. On the other hand, the respondents whose companies using BIM more than 60 percent of all their projects is 9.4 percent and less than 60 percent is 12.9 percent. Using BIM for more than 30 percent of all their projects are totally 22.3 percent. From the data, the bulk of the companies are still using BIM at the trial stage.

However, asking the question that the expecting use rate of BIM in their company in two years later, 19.9 percent respondent says more than 60 percent as an expecting use rate in the future. 30 to 60 percent as an expecting use rate is 29.2 percent. And the respondents who expect more than 30 percent of all their projects in two years reached 49.1 percent that is about the half of the respondents.

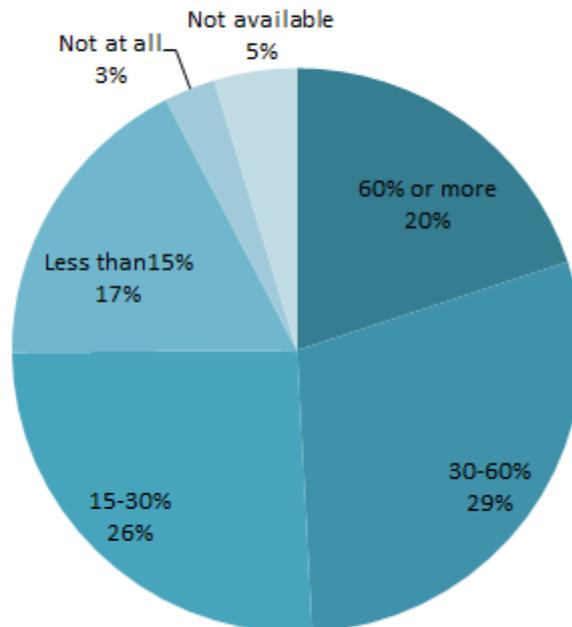
From the result, it can be assumed that the BIM applying project rate will rapidly increase in the near future. Now, since BIM has not used for very long time, the most of the companies are studying BIM technologies and at the same time educating the users in their companies.

However, in order to complete their real project on time, there are many cases that they apply BIM partially. Many respondents expects that BIM will be used more in the next two years explains that gradually quality and quantity of using of BIM is improving right now.

Current BIM Use (N=171)



BIM Use 2 Years from Now (N=171)



Utilization of BIM / Software

Choice of Architect's CAD Widened

BIM Software for Structure, MEP and Analysis Got Popularity

ArchiCAD and Revit Architecture are the two most used software for architecture design which is the majority usage of BIM. There are other CAD software that supports BIM such as Vectorworks, MicroStation, GLOBE and Allplan. Free software, SketchUp is also used. Besides architectural design, many companies have started installing software for structure, facilities and simulation that supports BIM.

Revit Architecture Expands Its Share to 40% in 8 Years

Asking question to the 171 respondents whose companies have applied BIM which software they use for BIM. The respondents are asked to choose from the lists in the question.

As a result, 45.6 percent uses ArchiCAD, and 39.8 percent uses Revit Architecture that are the two most used software and making big difference comparing with others.

Japanese version of ArchiCAD has long history as BIM software; it was released in 1994, 16 years before the survey. More, they started offering low price version in 2010 that costs about 300,000 yen which is extremely inexpensive price for BIM software. On the other hand, Japanese version of Revit Architecture was released in 2003. It should be noted that Revit had rapidly expanded its share up to about 40% in only 7-8 years of sales period.

The third most used software was 3D design software, SketchUp. 19.3 percent respondents uses SketchUp. The software is supporting to exchange data with variety of other software and it also has the free version, Google SketchUp. The early phase of architecture designing and presentation for the future project are the primary purposes. And, the software is widely used with other architecture 2D software due to its simplicity

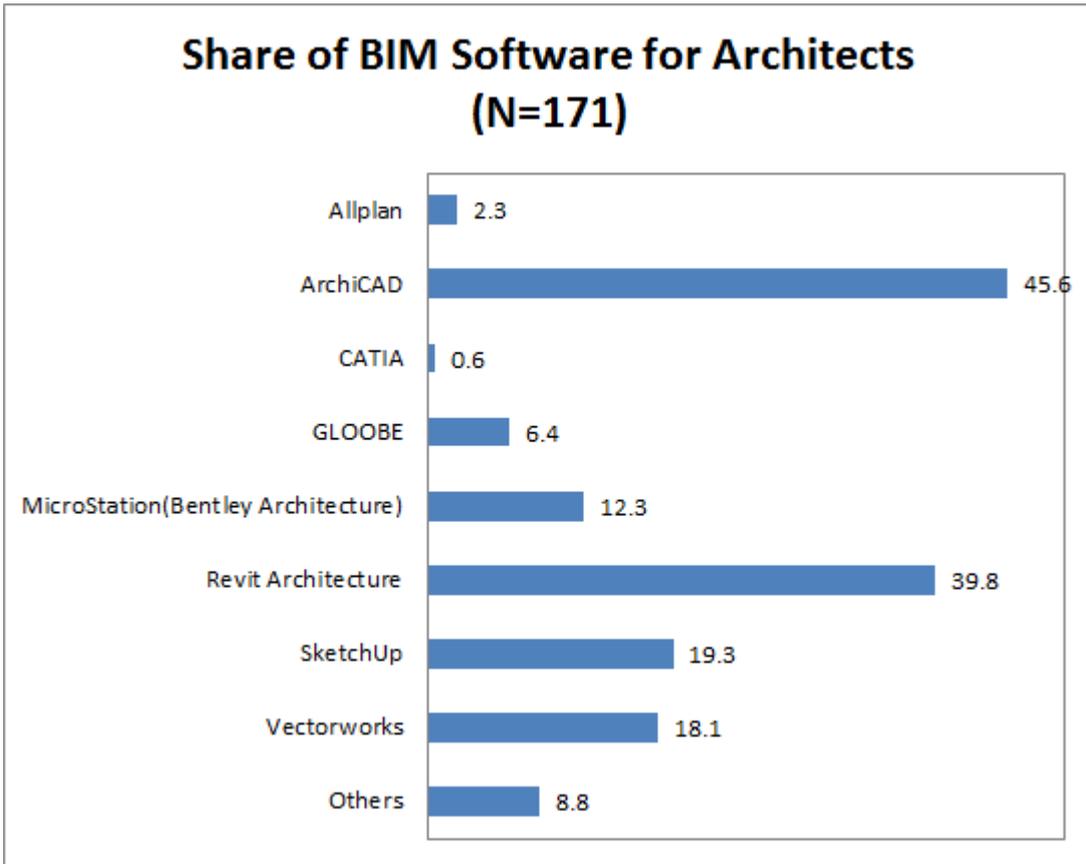
and easy usage.

The fourth software widely used is Vectorworks. 18.1 percent respondents use the software. Vectorworks had been promoted as a 3DCAD that enable to input property information, but few recognize the software as BIM. However, in the recent few years, they enhanced the software function such as applying BIM data exchangeable file (IFC data format) and material take-off. Thus, recently the software is more recognized as BIM software. The price is around 300,000 to 400,000 yen and it is relatively low price for architecture design software.

The fifth ranked MicroStation (Bentley Architecture). 12.3 percent respondents use the software. The software is major BIM software in the U.S and Europe. However, it is not widely used in Japanese architecture industry.

The sixth is the GLOOBE which has just started distribution in 2009. It is the domestic software. 6.4 percent of respondents use the software. 2.3 percent of respondents which is the seventh uses Allplan also started distribution in 2009. Both of them are newly promoted and first version has limited in its use of function. However, currently the both software are offering new version improved by more additional functions. Thus, increase number of new user would be expected.

Moreover, there are 6.4 percent uses ARCHITREND Z who responded to the question as “other software”. The software was originally developed for housing design. However, because of its good reputation for making construction documents and drawings, the architecture practitioners positively use the software by exchanging the data with other software.

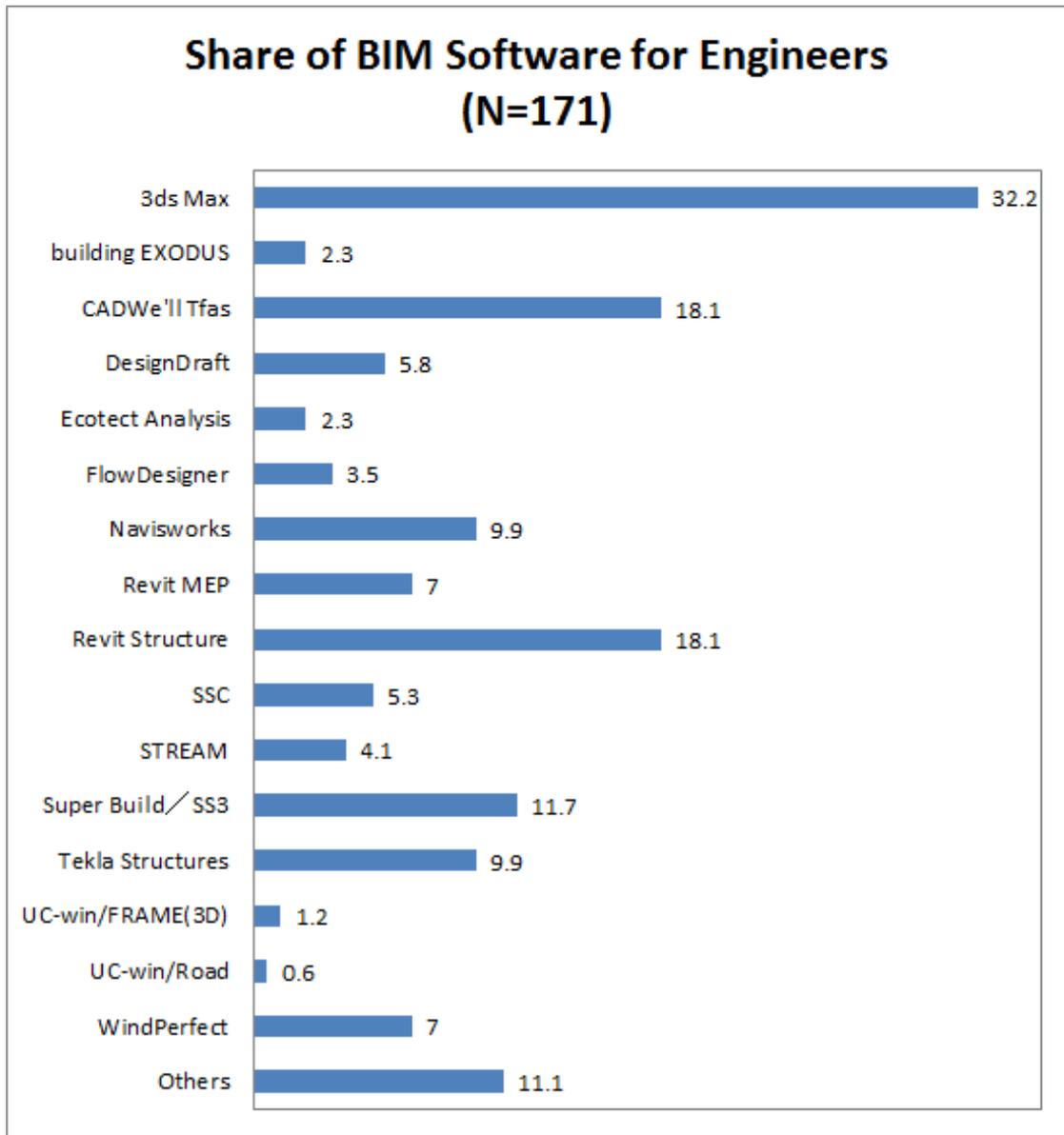


Structure Design and MEP Design Adopt BIM

The survey also asked about possessing and using rate of BIM supporting software for engineers. The most popular software is 3ds Max that enable to produce high quality CG images and animations for presentation. 32.2 percent of all respondents possess the software. Because the majority uses BIM for presentation purpose, it is presumed that they use the software to make presentation more competitive by producing high quality CG and animation.

Revit Structure which is used for structural design and CADWe'll Tfas which is used for MEP design are the two second most used software that both responses are 18.1 percent. The result explains that BIM has started to be used in structural and MEP design as well as architectural design.

Moreover, for structural design, Super Build/SS3 is used by 11.7 percent of respondents and Tekla Structure is used by 9.9 percent of them. For MEP design, SSC is used by 5.3 percent of respondents and Revit MEP is used by 7.0 percent of them. Navisworks is



the software combining architecture, structure, and MEP design together to consider design data and detect clashes is also used by 9.9 percent.

Many companies start using the simulation analysis software encouraged by the improvement of exchanging data between BIM software. Especially, computer fluid dynamics software (CFD) is widely used. WindPerfect is used by 7.0 percent of respondents. STREAM is used by 4.1 percent. FlowDesigner is used by 3.5 percent.

Energy simulation software is also used such as Ecotect Analysis is used by 2.3 percent. The building Exodus, escape and traffic line simulation software, is used by 2.3 percent. Elasto-plastic analysis software, UC-win/FRAME(3D) is also used by 3.0 percent respondents.

Case Study 2: BIM for Architects

Finding New Business for Architect by BIM

Yasui Architects & Engineers

There are varieties purposes using BIM in architecture design firms. Some firms focus on seeking a design using complicating curvature shapes. Others put more effort into analysis and simulations. Meanwhile, Yasui Architects & Engineers takes advantage of BIM modeling to seek a new design service that includes construction and maintenance management phase into view.

Top-Down Systematic Approach to BIM Implementation

Yasui Architects & Engineers introduced BIM company-wide in 2007. It is notable that BIM was introduced by top-down approach under the initiative of the president and principal architect, Mr. Yoshihiko Sano.

Since then, BIM implementation has been pursued in the company with well thought-out introduction schedule. Today, the company holds about 100 CAD licenses for BIM. The company also possesses many other licenses such as structural analysis software and thermo-fluid simulations software. Now, one third of architects of the company are non-BIM users and became a minority in the company.

The director of information and presentation group, Saburo Nakamoto says “Works for architects were to make drawings before. Now it has been changed to create design information. That is the large difference.”

The difference can be seen when a design work is hand over between architects. It was difficult to take over projects by drawings. But it became easier with a BIM model because the design information is stored by property information.

The company analyzed when and how design information was created in BIM model. They are reviewing the workflow of design process to consider how the system should be. Then, they seek to offer a new BIM service that includes construction and maintenance

management all together.



President Yoshihiko Sano(center) leads discussion using BIM (left, Photo: Ryota Ieiri). Drawing made from a BIM model expression differs by scale(right, images: Yasui Architects & Engineers)

50 % of Design Works Completed at Schematic Design Phase

The company quantitatively measures the BIM workload. They analysis the workload change in each design phases, and compare with the conventional design approach.

For example, with conventional drawing approach using 2DCAD, only 30 percent of all design works were completed at the end of schematic design. Then, more time was needed to consider and draw at the detail design phase.

However, when introducing BIM into the work process, about 50 percent of works are completed at the end of schematic design phase. It is because detail design information can be determined at the schematic design by BIM. These information used to be considered at later phase by conventional design method. Showing it in figure, it can be said to realize 20 percent of front-loading the work comparing with the conventional one.

For example, conventional way starts with drawing 2D plans to consider the program arrangements. Then, consider the elevation after the program arrangement fixed. If the client complains that “the size of window is too large” or “the façade design was not what they expected”, re-consideration and re-design should start from the plan again. Design rework occurs often times.

With BIM, plans and elevations are created simultaneously. When creating plans, it is possible to consider the shape of the roof and the window. Even in the schematic design

level, the front-loading effect is shown.

New Value on Environmental Assessment as “The Fifth Competitive Axis”

Using BIM, design visualization is not only about showing complete design image by CG. It is more about environmental assessment such as energy consumption and carbon emission which is hard to see by human eyes.

For example, using thermo-fluid simulation software, the interior heat load generated by the sunlight through the window is understood by seeing the visualized results at a glance.

“Peter D. Pedersen said in his book “The Fifth Competitive Axis” that strategy for green innovation and sustainability is the new competitive edge for corporate, in addition to self-innovation ability, market share, pricing and quality. Our company found the potential in BIM for innovation of design by building environmental assessment and energy savings.” says Nakamoto.

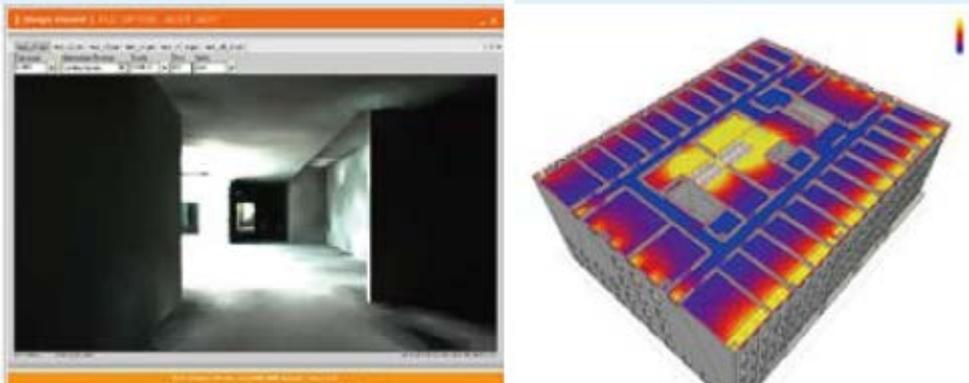
Aim for Realization of IPD Combining two of “BIM”

The company uses BIM for the ongoing project, new Hydrographic and Oceanographic Department Government office building (tentative name) which was ordered by the Ministry of Land, Infrastructure, Transport and Tourism, Kanto Regional Development Bureau. The project BIM data combines all the building frame, structure and MEP information together. The distinction of the project is not only using BIM for designing and construction phase but also aim to apply for maintenance management.

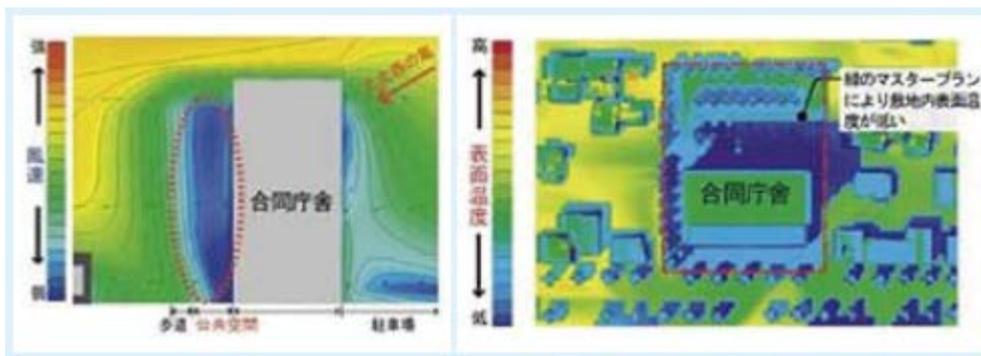
Usually, construction industry has little interest in operation and maintenance. But using BIM, it is possible to create a business model that manages building life-cycle as a whole from designing, construction to operation and maintenance. The company places facility management as one of the important new services.

Yasui architects & engineers trying to apply BIM not only as a virtual construction modeling system but also as a system that shares construction information with clients, architects, engineers, and contractors all who involving the project. The company will offer another BIM as a “Business Information Management” system in near the future.

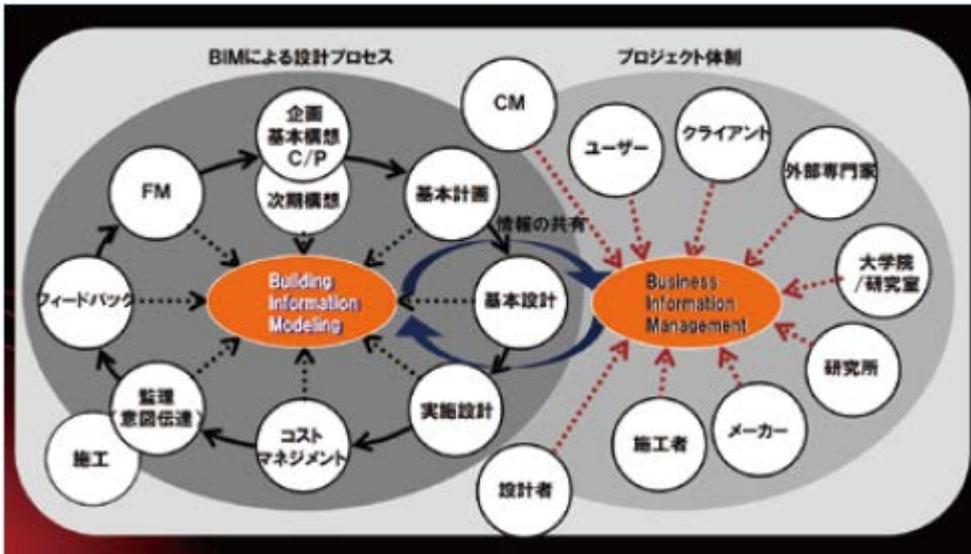
The company believes sharing of construction information between two “BIM”s leads to realization of IPD (integrated project delivery) that carries on the project with all the project members.



Daylight illuminance simulation for seeks the best use of the daylight



Computer fluid simulation around the building (left), thermo-fluid simulation (right)



Above figure shows the two “BIM”s, one for design process and other for project management team, sharing construction information for the realization of IPD.

Over 70% says “Business Efficiency was Improved”

Reduction of Rework and Errors was Effective

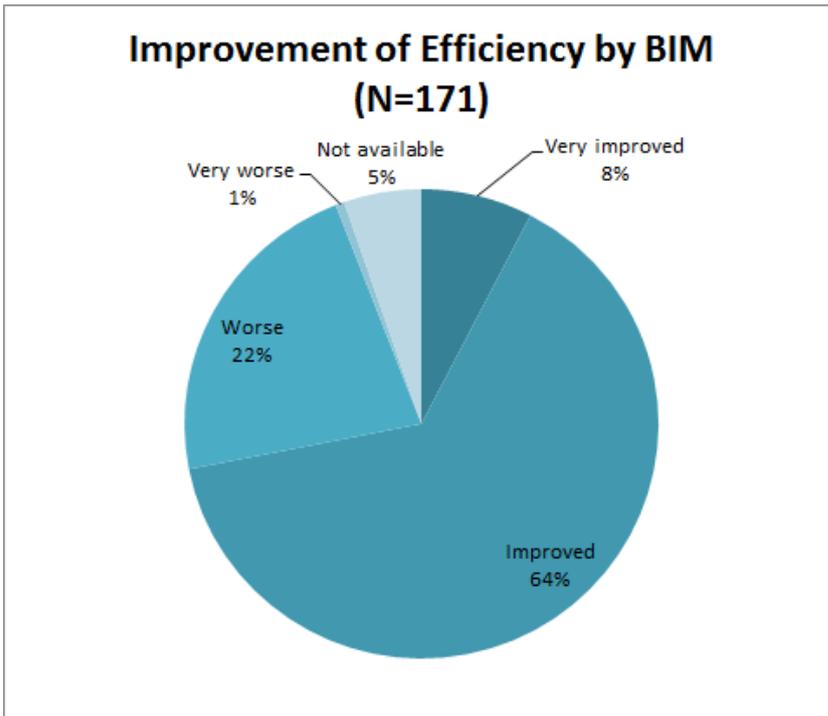
Over 70 percent of respondents answered that efficiency of work was improved by BIM. While only 22 percent answered efficiency was lowered. About 40 percent recognized that BIM reduced the rework and errors. Respondents also pointed out that BIM offered new services and gave good results due to integrated design and construction management. Over 20 percent of the company measured the efficiency improvement by BIM.

Over 70 Percent Answered Business Efficiency was Improved

The 171 respondents who introduced BIM in their office were asked whether efficiency improved by installing BIM or not. As a result, the responses that efficiency improvement is “very high” reached 7.6 percent, and “high” reached 64.3 percent. As a total, over 70 percent of the respondents think BIM improves the work efficiency. Meanwhile, the responses that efficiency is “very low” reached 0.6 percent, and “low” reached 22.2 percent. Total is over 20 percent.

The bulk of respondents acknowledge the business efficiency was improved by introduction of BIM.

Changing the design method from conventional 2D CAD to 3D BIM, educating the user is also needed. Users need a time for learning and familiarizing. Thus, it is possible that temporary efficiency decreases caused by educating users. However, the result of the survey shows that many respondents already realize the improvement of efficiency.



About 40% Pointed Out Reduction of Rework and Errors

Then, which part of work was improved by adopting BIM? “Reducing rework” is 39.8 percent and “reduced errors in construction documents” is 38.6 percent are the two most responses. They are almost equal rate responses.

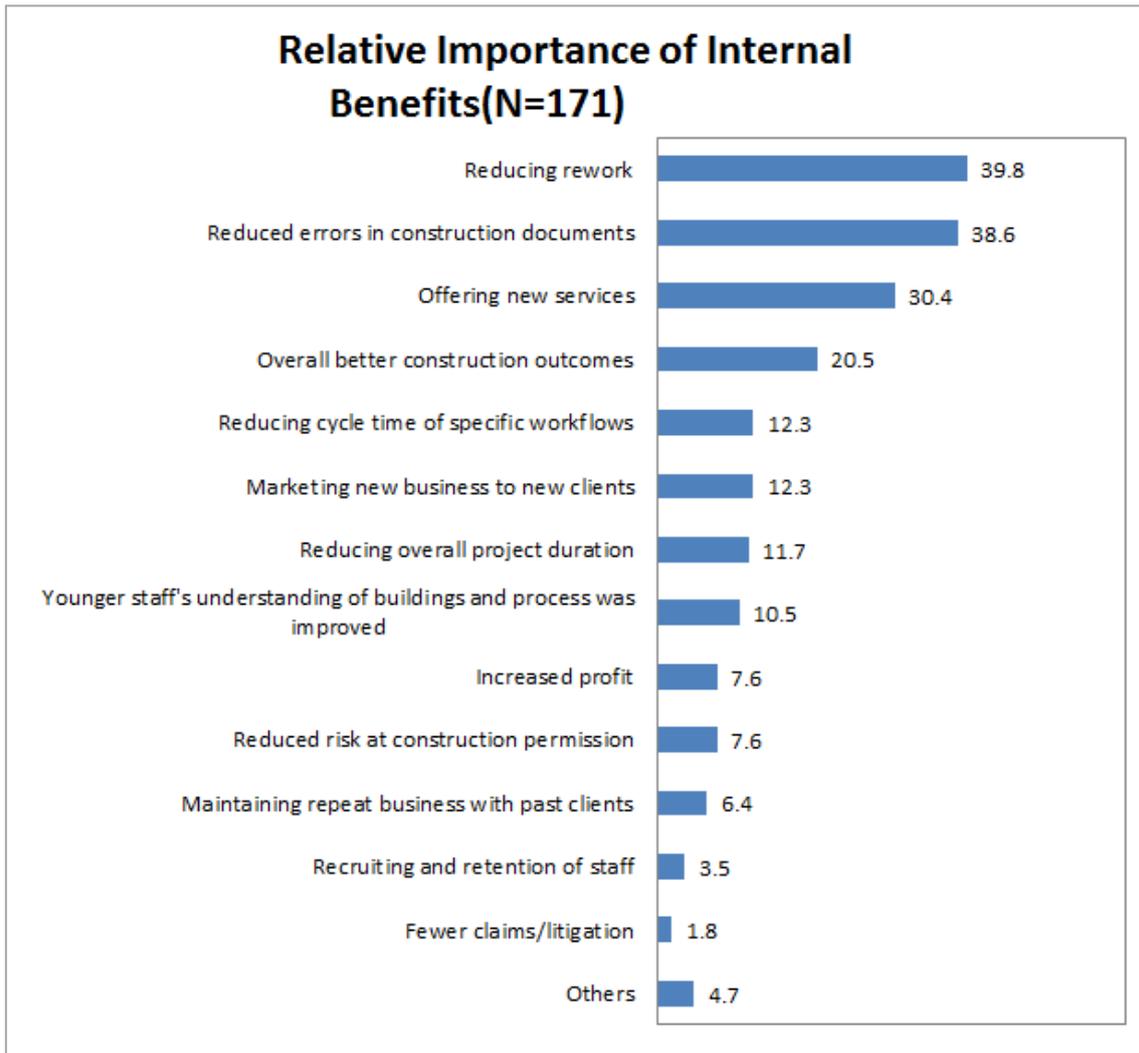
By using BIM, making 3D modeling makes easier to understand the design that facilitates consensus-building and reduces the rework.

“Offering new services” is also 30.4 percent. It points out that introduction of BIM produces new businesses that lead the profit growth.

Following answers were; . “Overall better construction outcomes” (20.5%), “Reducing cycle time of specific workflows” (12.3%), “Marketing new business to new clients” (12.3 %), “Reducing overall project duration” (11.7%), “Younger staff’s understanding of building and process was improved” (10.5%). Those answers are about improvement of quality, schedule, cost of the construction process and strategy of business growth that directly connect with the production efficiency.

It is also notable that some of the respondents said that increase in profits (7.6%), and

repeat business with past clients (6.4%).



Almost 10% Answered “Business Efficiency Improved over 50%”

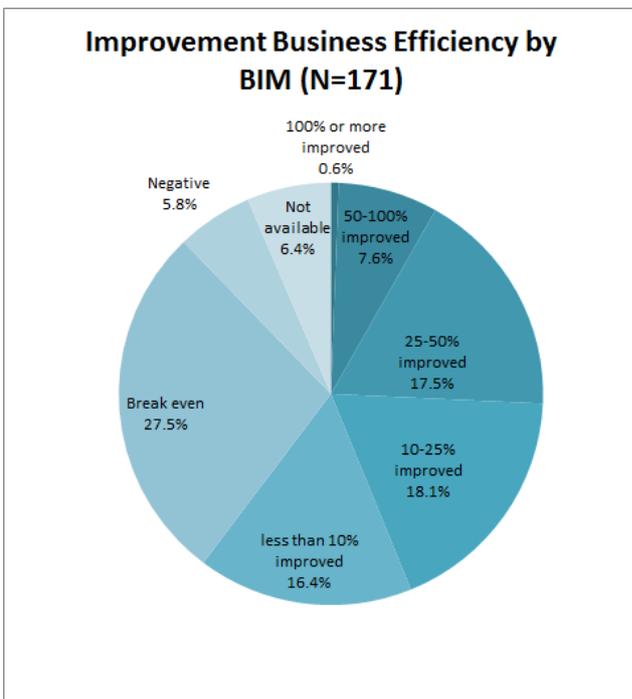
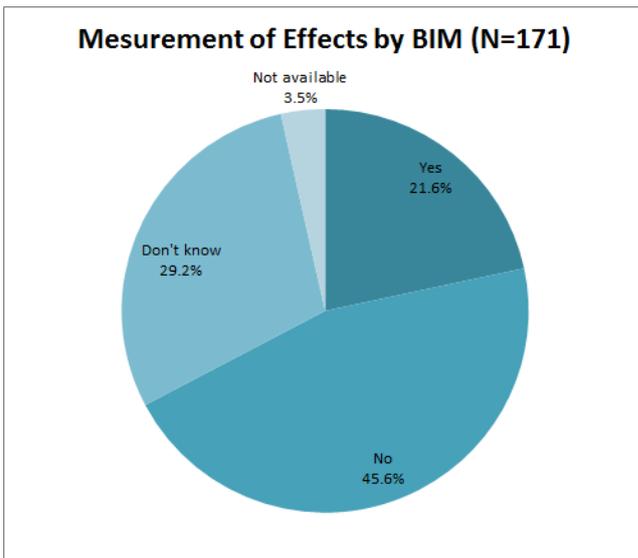
The 171 respondents who introduced BIM in their companies were asked whether companies measured the effect of the efficiency improvement by introducing BIM or not. 21.6 percent of them measured the effect. The result tells that the companies also recognize BIM as a tool to improve efficiency of work.

The respondents were also asked the rate of efficiency improvement of work by BIM. (The respondents whose companies did not measure the effect were asked to answer “perceived value”.) The result was that “more than 100 percent improved” (0.6% respondents), “50 to 100 percent improved” (7.6%), and “25 to 50 percent improved” (17.5%). Total number of the respondents reached a quarter whose company efficiency

improved more than 25 percent.

The answers that the work efficiency improved reached over 60 percent, including the “improved less than 10 percent” (16.4%) and “10 to 25 percent” (18.1%).

These results depict that the bulk of the company’s work efficiency has been improved by BIM.



Internal Business Value of BIM / Project Factors

Effective for Complex and Large-Scale Projects

Interoperability of Software should be Improved

When does the internal business value of BIM becomes higher? It is when "The data exchange is smoothly done between designers, the owner, and companies in a complex, large-scale project", the survey showed. To make the value of BIM higher many respondents thought it important that "Interoperability between software applications was improved", "Software, hardware, and data, etc. were made easy to use", as well as " Personnel training to use BIM".

Collaboration in Large-Scale and Complex Projects is Effective

The question "At what conditions does the internal business value of BIM in the construction project become higher?" was asked for 517 all respondents. Top answers were "Project complexity" (46.8%) and "Large project size " (45.5%).

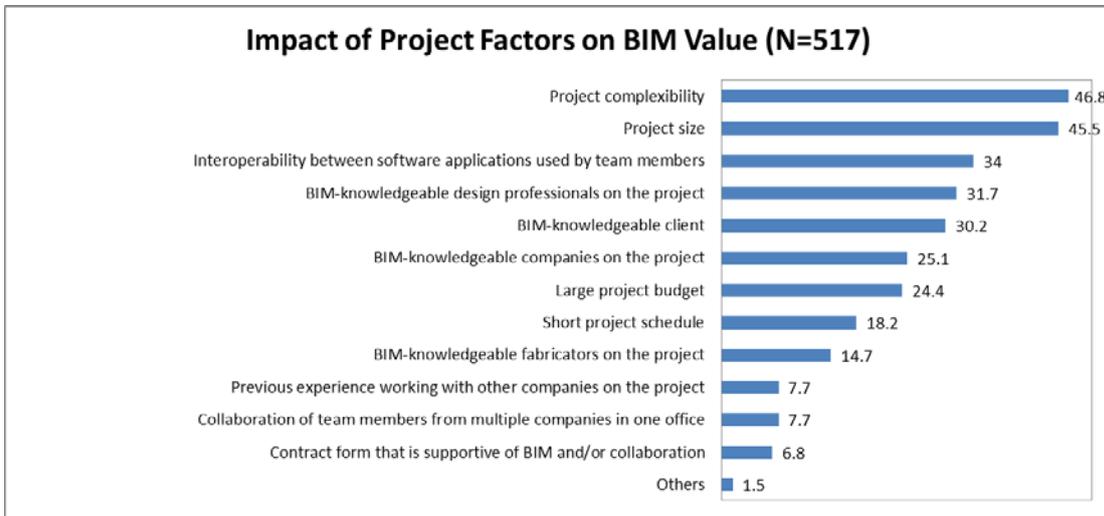
BIM makes it possible to make or revise CG and perspectives, floor plans, elevations, cross-sections efficiently from a BIM model, keeping compatibility between design documents. Door/window schedule and material lists are too. Therefore many respondents thought that the internal business value of BIM becomes higher in large-scale and complex projects.

Next major answers were; "Interoperability between software applications used by team members" (34.0%), "BIM-knowledgeable design professionals on the project" (31.7%), "BIM-knowledgeable client" (30.2%) and "BIM-knowledgeable companies" (25.1%). These respondents might expect prevention of repeated data input and smooth collaboration by sharing BIM model data among the people related to the project, and using various software applications.

The respondents who pointed out "Large project budget" (24.4%) and "Tight project schedule" (18.2%) were not few either. In order to finish a large-scale project in a short term with good quality, business improvement by BIM is necessary.

On the other hand, "Previous experience working with other companies on the projects" (7.7%), "Collaboration of team members from multiple companies in one office" (7.7%),

and "Contract form that is supportive of BIM" (6.8%) were lower than 10 percent.



Expectation for Interoperability and Increase of BIM Users

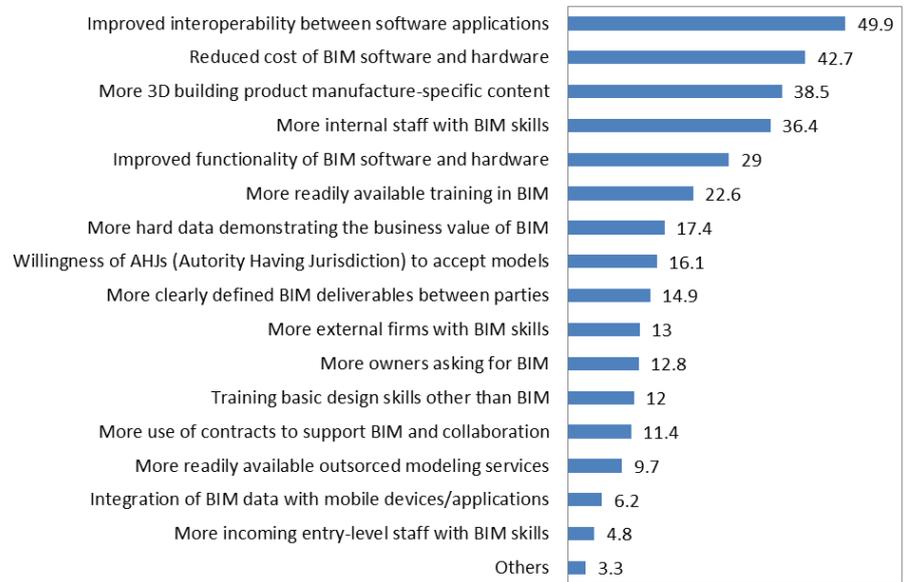
Top answer to the question "What are ways to improve value of BIM" was "Improved interoperability between software applications" (49.9%). Interoperability was seemed important for many participants of construction project to collaborate by BIM model data.

Next major answer was "Reduced cost of BIM software and hardware" (42.7%). It is necessary to reduce the risk cost-performance in introducing more expensive CAD software and higher spec hardware while effectiveness of BIM is unknown. Demand for reduced cost for software and hardware is deep-rooted.

In terms of staff with BIM skills, a few respondents pointed out "More internal staff with BIM skills" (36.4%), "More readily available training in BIM" (22.6%), and "More external firms with BIM skills" (13.0%).

Many respondents thought that it was important to increase staff with BIM skills inside and outside of their companies, and to make the collaboration easy.

Ways to Improve Value of BIM (N=517)



Internal Business Value of BIM / Productivity Enhancement

Understanding Improved by “Visualization” of Design

Productivity Varies by Level of Property Information Usage

Enhancement of productivity by BIM is achieved by "Improvement of communications and understanding level by visualization of design". Secured compatibility between design documents and reduction of work and cost in design change contributes much to enhance efficiency of the business. On the other hand, respondents also pointed out that improvement of customer satisfaction measurement would result in the improved productivity by good appearance to the clients and easiness of collaboration with the owner, too.

Highly Supported Design Visualization by 3D

The question “In what scene productivity has been enhanced by the BIM introduction” was asked for 171 respondents who had introduced BIM in the office. Top answer was “Better multiparty communication and understanding from 3D visualization” (74.9%).

The space is not expressed easily by 2D drawings which only the limited professional could understand, and design intention was not transferred enough between even professionals. Most respondents of BIM introduced companies felt the effects of design visualization by BIM model, which enables everybody understand content of design at a glance.

The answer "Easiness of compatibility between design documents" reached 34.5 percent. When the scale of buildings is large, it became difficult to keep compatibility between plans, elevations and cross sections by traditional 2D CAD. There must be some problems in the drawings.

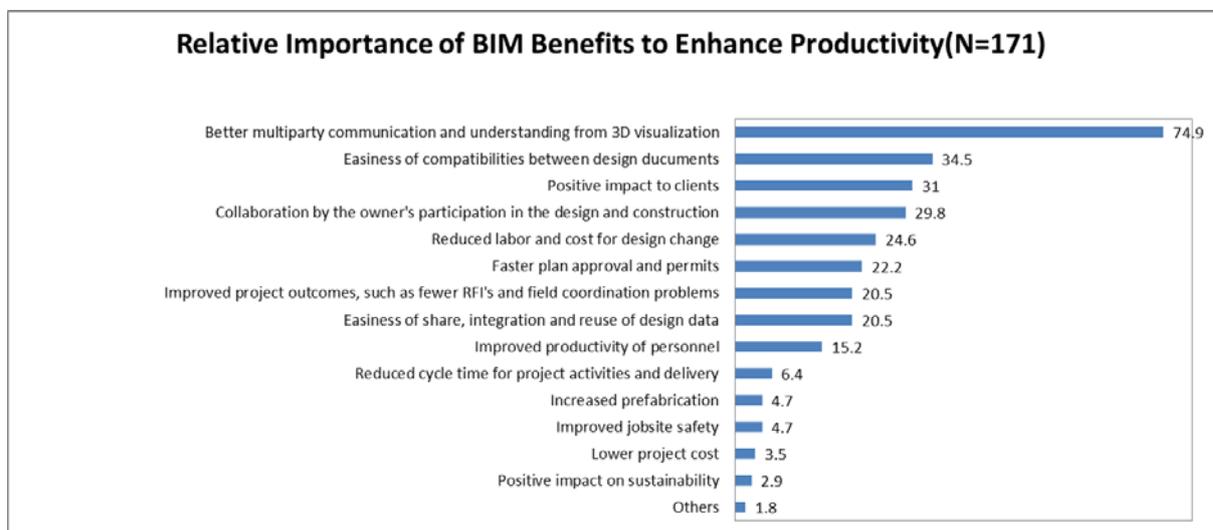
When construction documents like drawings, and doors and windows schedule are made from a BIM model, compatibility are automatically kept. Design changes in BIM model are also reflected to other design documents automatically. The labor for checking design is also reduced. Decrease of useless working hours rises the productivity.

About one third of respondents pointed out the enhancement of productivity in terms of relationships with the owner answering “Positive impact to clients” (31.0%) and

"Collaboration by the owner's participation in the design and construction" (29.8%).

In a long-term viewpoint, orders would be expected to rise by mouth - to - mouth advertising and repeated orders if esteem from clients was enhanced by BIM.

On the other hand, a few respondents pointed out productivity enhancement related to the construction stage such as "Reduced cycle time for project activities and delivery" (6.4%), "Increased prefabrication" (4.7%), "Improved jobsite safety" (4.7%), and "Lower project cost" (3.5%). It can be said that BIM is used mainly for design works at this time, and the productivity enhancement in the construction stage would be discussed hereafter.



Use Level of Property Information Affects Business Improvement

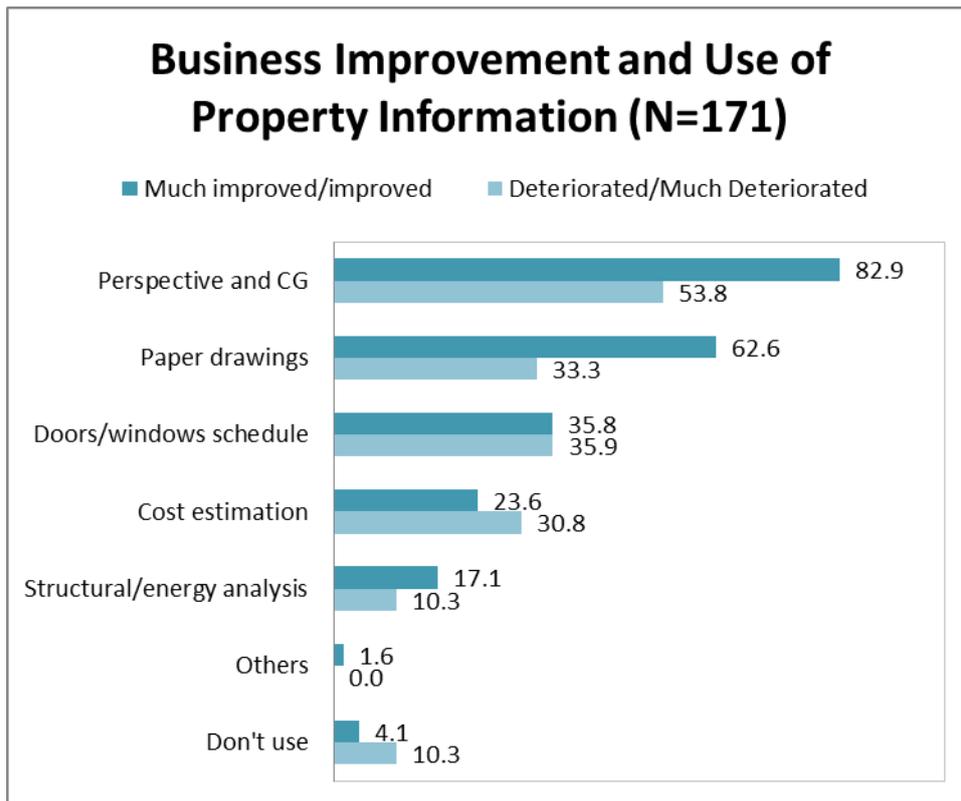
The productivity enhancement by introduction of BIM closely related to the business improvement. In order to analyze the relationships between the level of BIM use and business improvement, answers form respondents who use BIM in the office were split into two groups; business efficiency was "Improved" and "Deteriorated" by introduction of BIM. Property information that respondents input in the BIM models is shown in the chart.

Respondents in the group of "Much improved / improved" input property information needed for perspective and CG, paper drawings, structural/energy analyses in a high ratio. It is easy for recent BIM software to demonstrate above effect. Therefore, use level of property information seems to lead to the business improvement.

On the other hand, respondents in "Deteriorated/much deteriorated" input property

information for “Doors/windows schedule” and “Cost estimation” more than another group.

Introduction of BIM itself does not lead to productivity enhancement. It can be said that productivity enhancement can be achieved by thoroughly examining which works to raise efficiency, and inputting necessary property information systematically, and using it in a series of workflow.



Case Study 3 : BIM for General Contractors

Front-Loading Problems of Construction Stage Upstream

Shimizu Corporation's Yokohama Branch

Value of BIM for general contractors is found in the productivity enhancement in the construction stage. Shimizu Corporation's Yokohama branch inputs detail size and position of members at the design stage by "front-loading", which accelerates works at construction sites. BIM is also used at the construction stage as a communication tool between various specialty contractors such as steel fabricators, builders, exterior and interior finishers, and MEP contractors, etc.

Constructability is Considered by BIM from Schematic Design

Shimizu Corporation's Yokohama branch works on the BIM use to improve the productivity of the construction stage. The point to make the best use of the strength of BIM "Easy understanding by 3D visualization" is similar to the case of architects' case. However, the application field is wider ranging from the quality control in construction to the material order and the construction process management.

It would characterize the BIM use in general contractors to visualize hidden space and time by BIM, collaborating with specialty contractors and fabricators which is related to construction works.

Designers of Shimizu corp. design artistic interior and exterior, structure and MEP equipment while considering works at construction sites The work flow of the design has changed from "Handing over method" in which design works are done one by one, to "Scrummage method" in which all design works are done at the same time.

Front-Loading By BIM Parts for Exterior

From the view point of execution management, it is desirable to order the steel frame members earlier in the project. Usually, position and size of material called "Fastener" that holds the sash and the exterior material had not decided until the verge of construction work. It delayed production of the steel members.

Shimizu Corp. Yokohama branch, adopted "BIM parts"(3D CAD parts) of precast

concrete slabs and extruded cement panels with detail positions for installation input.

When designers put these BIM parts on the building model, detail positions of connecting points of steel members are automatically decided. It can be said that the front-loading that uses BIM parts.

When engineers at the construction site find problems in some building products, the information is input in the BIM parts for later reference, then fed back to next designs. This work flow is a combination of BIM and continuous improvement by “P-D-C-A” (Plan-Do-Check-Action).

BIM Solves Problems of Space and Procedures by Visualization

Interference of members is often the problem at construction sites. When there seemed no problem in 2D drawings, it often occurs that members cannot be installed by interference. As number of reinforcing bars increased in recent buildings, interference of rebars disturbs bar arrangement and placing of concrete.

In order to prevent these problems, Shimizu Corp. Yokohama branch confirms the constructability of concrete parts, structural parts, and MEP parts by BIM model of the standard floor. For junction members where rebars are closely arranged, rebars are 3D modeled and examine constructability of bars and concrete considering the diameter of rebars.

At construction sites with limited space, it is necessary to move the position of material stock yard and construction machineries to the stages of construction work. They make BIM model of each stage of construction work such as placing foundation piles, construction of underground structures, and installation of steel members considering time. They simulate the construction process to examine the problems related to space and time. The information is shared to other companies relating construction work and streamlines the construction works.

Working Drawings Made in Construction Site

Receiving Order Using Experience at Virtual BIM Competition

The branch started to use BIM from basic planning and design development stages, and extended BIM use to construction stage. Finally BIM use at construction sites began, buildings for a telecommunication company and a car dealer.

Young engineers who take charge of these sites used BIM after receiving BIM training of

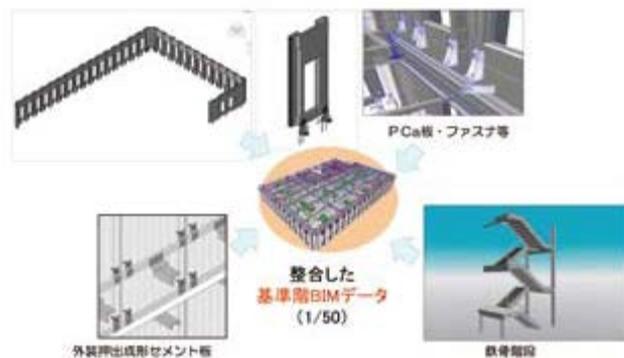
about two weeks, making working drawings, presenting to site supervisors, and examining bring in and installation of MEP equipment.

BIM use that makes the best use of construction know-how strengthened their power to receive order of projects.

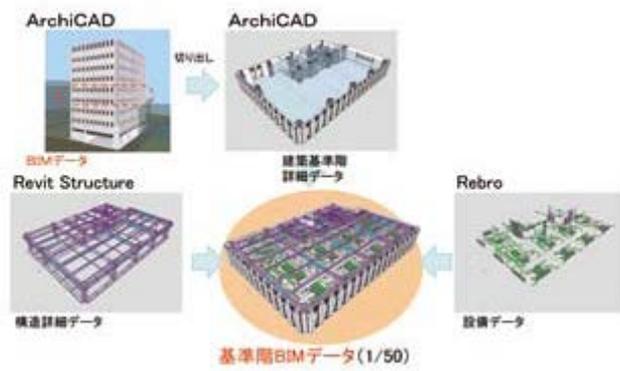
Shimizu Corp. participated in BIM virtual competition "Build Live Tokyo 2009 II" on the Internet in 2009, and acquired the Grand Prix award. More than 20 members were organized again in a project team and collaborated to receive the order of reconstruction of apartment buildings.

Using experience at the virtual competition, they made presentation from demolishing to construction of foundation, frameworks and exterior, including local resident's safety and environmental preservation, so that the client could understand easily. Then they received the real project.

For general contractors, big advantage arises in achieving the "front-loading" that solves problems in construction, operation, and operation and maintenance of buildings in the design stage by BIM. Therefore, another problem is surfacing about scope of work among the traditional organization that is divided into the design section and the construction section, and communication of information, etc.



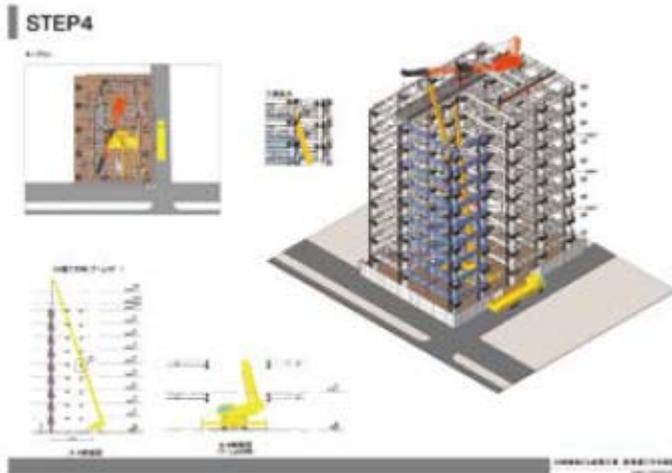
Detail position of fasteners are automatically determined by placing BIM parts of exterior members on BIM model (images and photos: Shimizu Corp.)



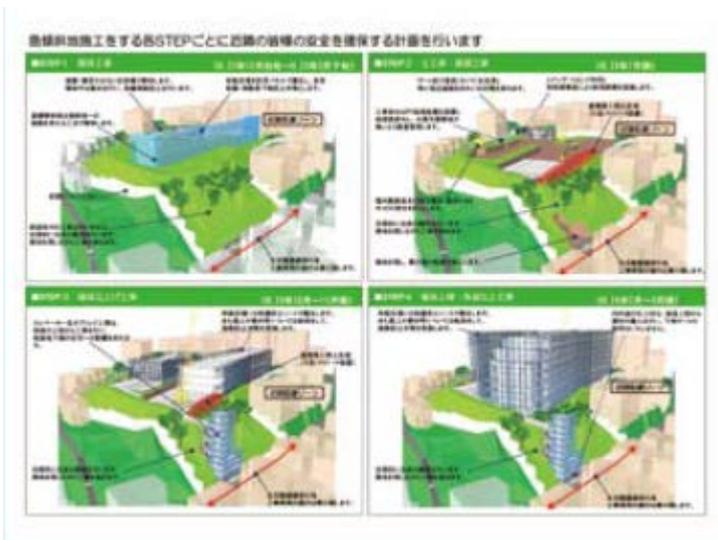
Interference inspection by BIM model combining frameworks, structures and MEP equipment of standard floor.



Design work by BIM software at Shimizu Corp.'s Yokohama branch.



Examination of position of construction machineries and bring-in vehicles, and construction procedures by BIM models which were made to stages of steel members installation.



CG images of construction planning that was used to receive a real order of reconstruction of apartment buildings. Experience at the virtual BIM competition were applied.

Project Value of BIM / Project Phases

Effectively Used at the Upstream Stages of Construction

Value is Found to Improve Overall Quality of Projects

Many respondents think that value of BIM is higher when used at the upstream stage of construction projects, such as predesign study, schematic design and design development. At the latter stages, in detail design, structural/MEP design, cost estimation, the lower they evaluate value of BIM. This trend is similar in execution management, supervision at site, and operation and maintenance. It is known that the advantage of BIM has not been used enough at the downstream stage of construction projects.

Most Value in Schematic Design

A question "At which stage of the construction, project value of BIM exists?" was asked to all 517 respondents. Top answers were; "Predesign" (43.1%), "Schematic Design" (52.2%), and "Design Development" (42.6%), which were all at the upstream of projects.

Respondents may enjoy the effect of BIM in presentation for clients and receive orders by explaining the design visually, and modifying design flexibly reflecting the client's demands.

Value of BIM performs when designers develop design smoothly using 3D CAD for BIM, building consensus with the client by design visualization. In these works, the function of software and design data are used efficiently.

Less than 30% of respondents pointed out that "Detail design" (28.2%), "Structural design" (29.0%), "MEP design" (28.6%), "Construction documents" (23.4%), and "Cost estimation" (27.5%) as value of BIM.

The reason why the score of "Detail design" was relatively low may be that know-how of making detail drawing from BIM model had not been developed enough, and data for detail design were not supplied compared to schematic design.

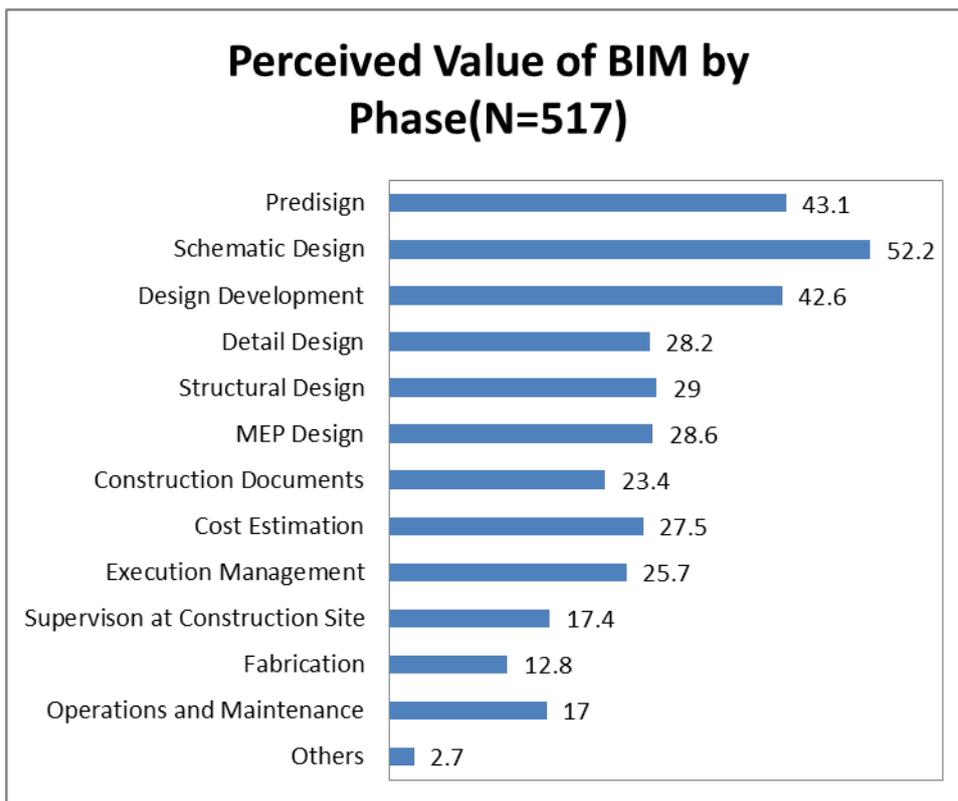
As for construction documents, detail design documents such as drawings for construction site were hard to make from BIM model and 2D CAD was still more efficient.

This seems to have appeared in the result.

As for structural design, though CAD software for structural design was sold, it took much time to exchange data with structural analysis software, and interchangeability with software with minister authorization was not enough. And it is likely that as architects and structural engineers work separately in different section of a company, their collaboration by BIM is not easy. The result may reflect such a situation.

Design works of MEP designers should become easier by getting the BIM model of the buildings from architects. However, 2D CAD is still main tool for MEP designers, the advantage of BIM or 3D CAD may be hard to come out.

Answers at construction and later stages were as follows; "Execution management" (25.7%), "Supervision at construction site" (17.4%), "Fabrication" (12.8%), and "Operation/Maintenance" (17.0%).



Project value of BIM is "Improved Overall Project Quality"

Top answers to the question "What is the project value of BIM" were "Improved overall project quality" (48.7%) and "Reduced conflicts during construction" (46.0%). These surpassed "Improved collective understanding of design intent" (42.6%) and "Reduced

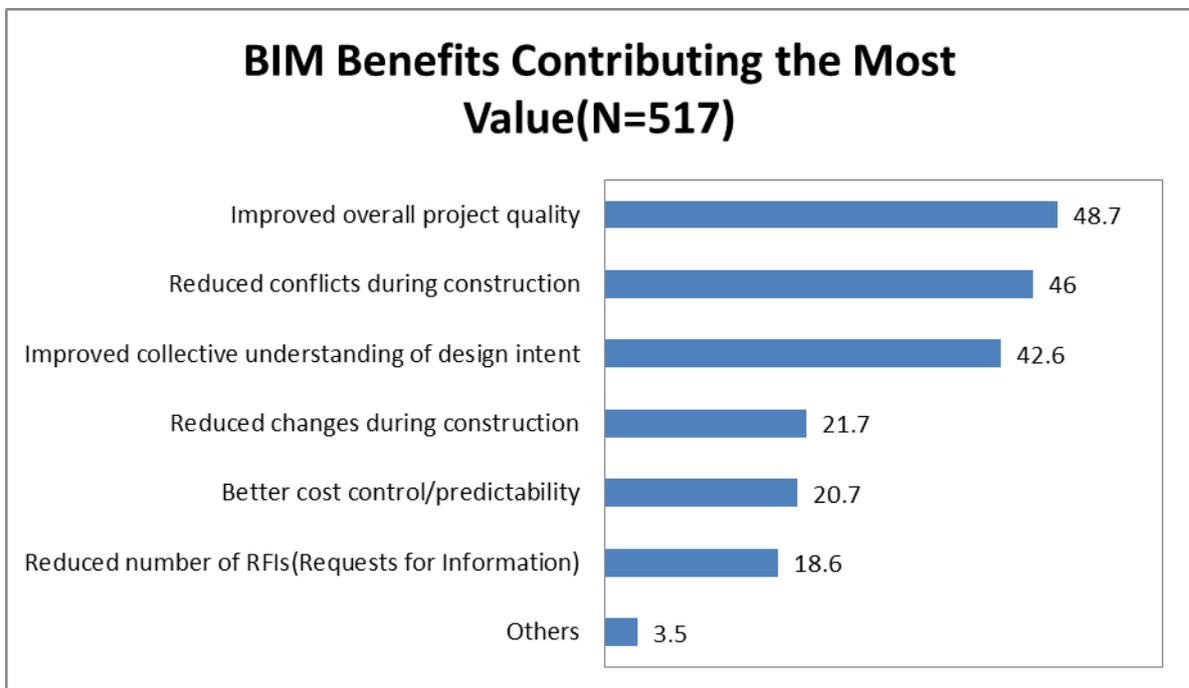
changes during construction" (21.7%).

These results means that project value of BIM are found in "total optimization" which includes overall project from design to construction and maintenance rather than "sub-optimization" for specific jobs.

However, the problems at the downstream of projects, such as construction and maintenance are not solved enough in design stage by "front loading". The reality is that BIM has been introduced partly while a high wall remains between designers and contractors.

It can be said that architects are merely improving productivity and quality of design using BIM software without front loading problems at the downstream.

The project value of BIM will be distributed uniform at all stages of project if BIM is becomes more popular at the construction stage, and solving downstream problems in the upstream become natural in the future. Then it would be important to reconsider the work share between architects and contractors, and fee for both professions.



Project Value of BIM / BIM in the Future

“Ability of Prediction” Evolves in 5 years

Collaboration with “CASBEE” Improves Sustainability of Buildings

Most of improvement in coming 5years by introducing BIM into the AEC industry relates to "Prediction ability of the result". It has been difficult to image finished state of buildings by design expression by drawings. It caused changes of design, and errors in design, and the result was not clearly predicted. Many respondents think such problems would be solved if BIM that can visualize completed state of buildings by 3D is used.

Review and Approval Cycles Improved by BIM

Top answers to the question "What will be improved by BIM in five years from now?" were "Improved review and approval cycles" (45.8%) and "Better-designed projects" (44.3%).

Next majority were; "Lower risk and better predictability of outcomes" (36.6%), "Better performing buildings/infrastructures" (22.8%), and "Reduced claims, disputes and conflicts" (22.2%).

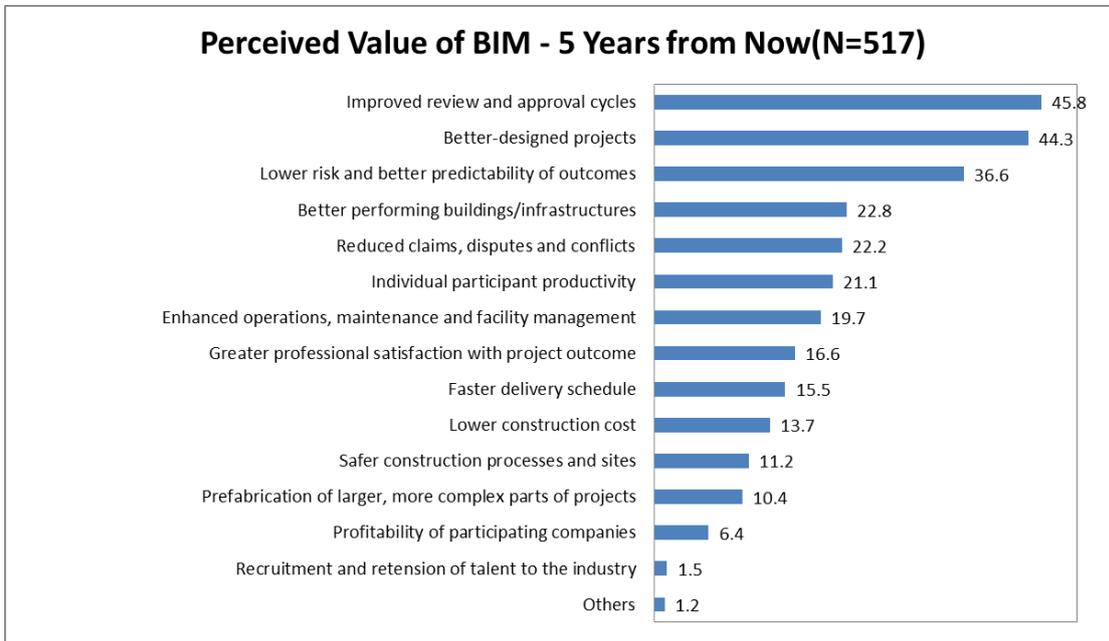
Design work is to predict the completed state of buildings in the future, and express it on design documents. Many respondents pointed out in this question such problems as change of design, risk and claims which were caused by “Lack of predictability”.

Regardless of good design or bad design, BIM has power to visualize design contents so that everyone can easily understand. In other word, BIM has function like a "Time machine" in which everyone can see the completed state of buildings in the same image. Therefore, consensus building becomes possible by predicting many aspects of the building beforehand.

Design and construction using BIM make it possible to utilize “Power of prediction” in every aspect in the project. Many respondents seem to have forecast the solution for their problems by the BIM power.

Answers “Individual participant productivity” (21.1%), " Enhanced operations, maintenance and facility management" (19.7%) and "Greater professional satisfaction

with project outcome " (16.6%) were around 20%. These respondents may expect that work that can be done by BIM should be automated, and designers and engineers should concentrate on essential works. They want improve quality and efficiency of their works.



Lower Interests for Construction Works Improvement

Next answers followed; "Faster delivery schedule" (15.5%), "Lower construction cost" (13.7%), "Safer construction processes and sites" (11.2%), and "Prefabrication of larger, more complex parts of projects" (10.4%). These were related to improvement in the construction stage.

The reason why elements in construction stage were not popular was because more than half of respondent's related to design works. However, if "Ability of prediction" is applied to the construction stage, it may be possible to make construction drawings which solve problems at jobsite beforehand.

If such drawings are realized, prefabrication of building members will be accelerated. Then site works will be mainly the assembly of the members. The more the site work becomes simple, the lesser workers are needed and accidents at the site might be decreased.

Shortening the construction term and reducing the cost directly enhance income from the project. The answers to expect the improvement of the construction stage may be more if

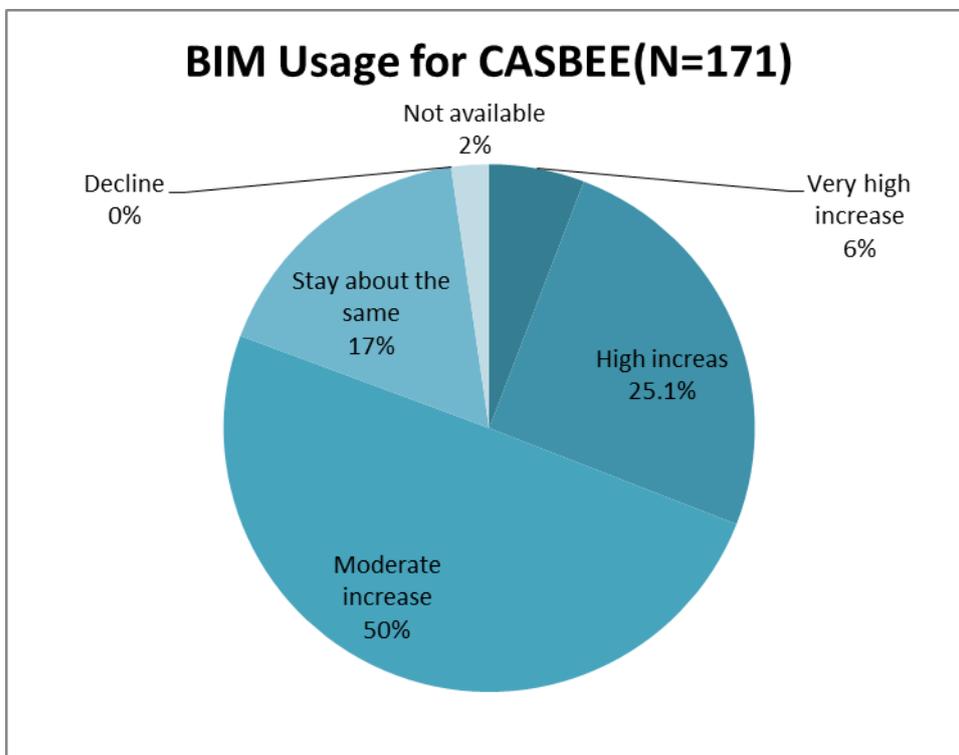
respondents include more contractors.

Improvement of Sustainability by BIM is Expected

The question "Do you think that the use of BIM increases for "CASBEE" evaluation in future?"(CASBEE is Japanese sustainability evaluation index of buildings like LEED) was asked to 171 respondents who had introduced BIM in the office. As a result, 30% of respondents expected the collaboration of CASBEE and BIM to become strong, combining "Very high increase" (5.8%) and "High increase" (25.1%) together. On the other hand, no respondent answered "Decline".

49.7% of respondents answered "Stay about the same". However, it has been cleared that the greater part of respondents thought that there were strong relationship between use of BIM and improvement of sustainability of buildings.

Autodesk and Japan Sustainability Building Consortium developed software "Revit Extension for CASBEE" which automatically evaluate a part of CASBEE like PAL(Perimeter Annual Load) value and daylight ratio, etc. It has been released since October, 2010. Software similar to this is planned to be released by, other BIM vendors in near future.



Case Study 4 : BIM for Building Facility

Making BIM Parts for Popular Products. Aim Maintenance Field.

Toshiba Elevator and Building Systems Corporation / NTT Facilities, Inc.

BIM use in the building facility fields is important because it rationalizes the design, construction, and the operation and maintenance in the entire building process. Toshiba Elevator and Building Systems Corporation made BIM parts of their elevator and the escalator products for which special know-how is necessary for the design, and provides the design services. NTT Facilities, Inc. that manages about 21,000 buildings started 3 year project that contemplates the operation and maintenance in the building by BIM.

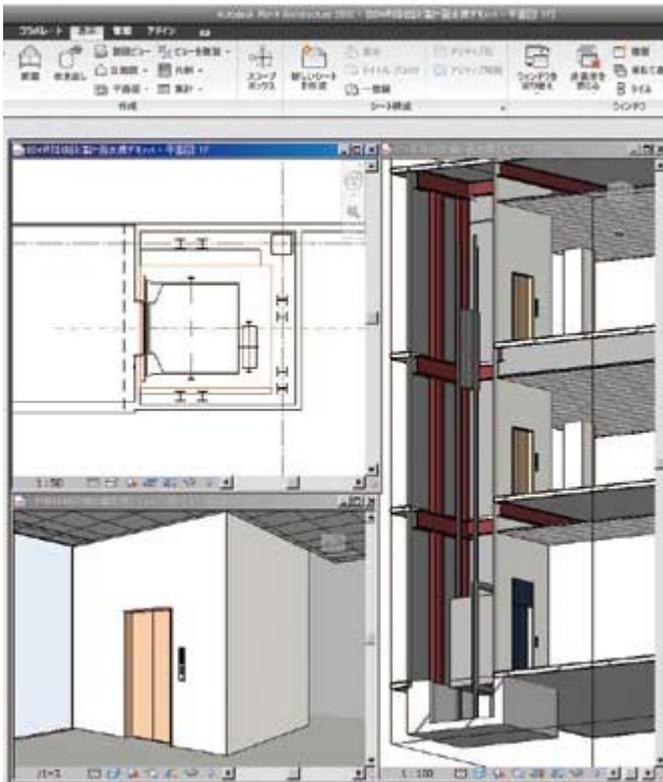
BIM Design Services for Popular Models

The Toshiba Elevator has been providing the design services of their elevators and the escalators for customers by 2D CAD. Although they have been improving the efficiency of the design work by customizing 2D CAD, they introduced BIM in 2008 for the next stage.

In 2009 they made BIM Parts for popular models of elevator and escalators which conform with JIS(Japanese Industry Standard), and started design services by BIM for the contractors and the architects.

The procedure for Toshiba Elevator begins to receive the BIM model data and/or the drawings of the building from customers. Toshiba Elevator adds BIM model of the location, space, etc. necessary for the installation of the elevator and the escalator, then returns it to the customer.

Mr. Kazuo Hirate, Project Promotion, Information System Department of Toshiba Elevator explains the advantage of BIM. "Because the elevator and the escalator are the transportation equipment through the floors, the flat position of each floor should be fit. By using BIM, we can allocate exact location in each floor".



BIM parts of elevator built in building.

Install Catalogue Spec in BIM Parts as Properties

It is necessary to allocate the position of elevators at the early stage of the design. Because a detailed structure of the building might not be decided at that time, the BIM model offers the position, the size, and the shape of the space that should be reserved in the building.

When the construction work starts and design in construction drawing level is needed, detailed design information of connection with the stiffening or structural members should be determined. At this time, Toshiba Elevator provides detail design information by BIM model.

Specs described in the catalog of the elevator and the escalator such as model name, basic specification, etc. are buried in BIM parts as properties. Logical check functions, too. For example, when floor height exceeds the allowance, the BIM parts “Alert message” is shown on the BIM software. That is manufacturer’s know-how embedded in

BIM parts.

Toshiba Elevator afraid that if their user changes the size and the specification of BIM parts by themselves, it might cause some troubles. Therefore, Toshiba Elevator does not embed data which seem to become a problem in the BIM parts, and does not provide BIM part itself to users.

識別情報	
製造メーカー	東芝エレベータ
製品名	ガイドムーバー
形式	TE-D1000
コメント	
マーク	
フェーズ	
作成されたフェーズ	新築
解体されたフェーズ	なし
解析結果	
階高チェック	適用階高を超えています
中間支持梁	中間支持梁が必要です
その他	

“Alert message” is shown by logical functions embedded in the BIM parts if the floor height or span exceeds the limit.



CG perspective made with BIM parts of escalator.(above 3 images: Toshiba Elevator)

Difficulty in Collaboration Between Companies

The collaboration by BIM between architects and contractors has not been activated actually yet. The design of elevators is often requested at the stage without even the drawing exists, not to mention the BIM model of the building frame. Even if drawings are

available, a lot of information of the building is cut out, only the vicinity of the elevators or escalators is given from the customers. It is thought that various factors like copyrights of the BIM model, the security protection of the building design, and the designer's obligation to keep secrets of the owner are barriers to collaboration by BIM.

As for the BIM use in the facility field, the maintenance of the equipment at the operation and maintenance stage and use in repair works are easily thought of. However, Toshiba Elevator does not start full scale discussion about the BIM use in maintenance management stage yet.

Mr. Kenichi Okada, Group Reader of Project Promotion, Information System Department of Toshiba Elevator says, "The repair works of the elevator and the escalator will be done after 20 years of completion. The maintenance works are being done by completion drawings, the manual, and the equipment data sheets".

The approach with a long term view may be indispensable for the BIM use in the operation and maintenance. Because the repairs are required after 20 years completion of elevators and the escalators.

Challenge of BIM Use From Design to FM

NTT Facilities introduced BIM in 2009, and works on the 3-year plan to expand the use of BIM. BIM has been used for planning and fundamental design of 6 projects such as production facility, hospital, and office building, etc. as of November, 2010. The floor space of the buildings varies from 1000m² up to 100,000m².

They are using BIM to determine material and color of buildings in earlier design phase while doing the communication with the owner by CG perspectives now. However, they are expanding the BIM use to detail design, the construction supervision, and maintenance stages in future.

NTT Facilities is managing about 21,000 buildings. Mr. Masahide Watanabe, chief of engineering department, Facility Management Business Division, says, "Facility maintenance works have been done by management sheets. But we are planning about the real time management system to watch where and how many equipment are working by BIM".

"The advantage of BIM is that information on various drawings, sheets, manual, and maintenance histories, etc. can be jointly managed. If it comes to be able to use

information on one building efficiently, the explanation to the owner and the consensus development can be easier”(Mr. Watanabe).

In order to use BIM in FM stage in coming projects, the key factor of success is the BIM model data relay from design to construction and operation/maintenance.

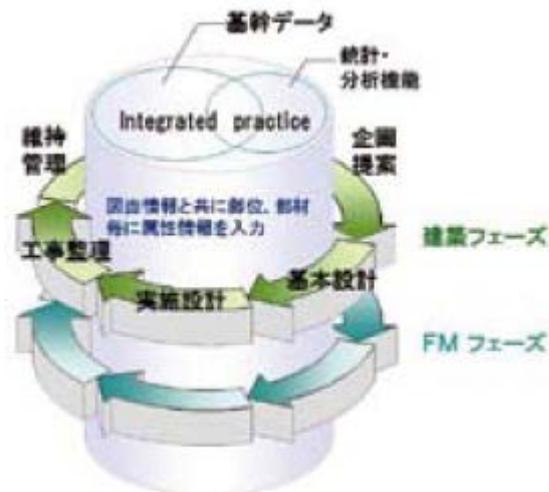


Image of digital mock-up of life cycles.



CG simulation of elevator hall.(above 2 images: NTT Facilities)

Player Value of BIM / Project Participants

Architects Receive Most Value of BIM

MEP / Structural Engineers and Owners too

Most people think that architects receive the most value of BIM among various players. The next was MEP designers, then contractors, structural engineers and owners in the same level. In contrast, speciality contractors and building product manufacturers receive relatively lower value of BIM. However, the respondent who has introduced BIM in the office uses the advantage of BIM by about 90 percent, might find some meanings to the introduction of BIM.

High Score for Architects' value of BIM

The question "Who receive the value of BIM in each player when BIM was used over the whole project?" was asked. As a result, most respondents thought that architects receive it most. For architects, "very high" (25.9%) and "high" (40.0%) occupies about 2/3. On the other hand, the total of "negative" (3.7%) and "low" (1.4%) is 5.1%. "break even" (25.0%) was the fewest in all players.

This result agrees with the result of "Perceived Value of BIM by Phase" (30-31 page). Because the result showed that the value of BIM is high in stages of predesign, schematic design and design development of projects, and architects conduct these works.

Next, MEP engineers designer follows. For MEP engineers, "very high" (22.2%) and "high" (34.6%) occupies 56.8%. This score is higher than that for structural designers (50.3%). this is because MEP engineers often face more rigid conditions of delivery time and design space than structural engineers. Developing MEP design by BIM software based on the BIM model of buildings makes it possible to find errors and revise them at the earlier stages of the project.

Project Participants Who are Perceived to Experience the Most Value(N=517)



Attention to the Owners' Value

Attention should be paid to the owner's value of BIM. For owners, "very high"(19.1%) and " high"(27.9%) occupies 47%. Almost half of respondents admits the value of BIM for owners.

If some mismatches causes between the owner and the designers, they are often overlooked at the time when only paper drawings are used for design development and design approval. It would be likely that the owner notices the fact of the difference after construction works almost finished and gives up design correction.

The majority of the respondent are the designers and construction managers, and they often communicate with the owners and feel their reaction when completing buildings. It is thought that the respondent is expecting power to visualize the content of the design by using BIM and if owners forecast the result of design by BIM, many of past problems can be solved.

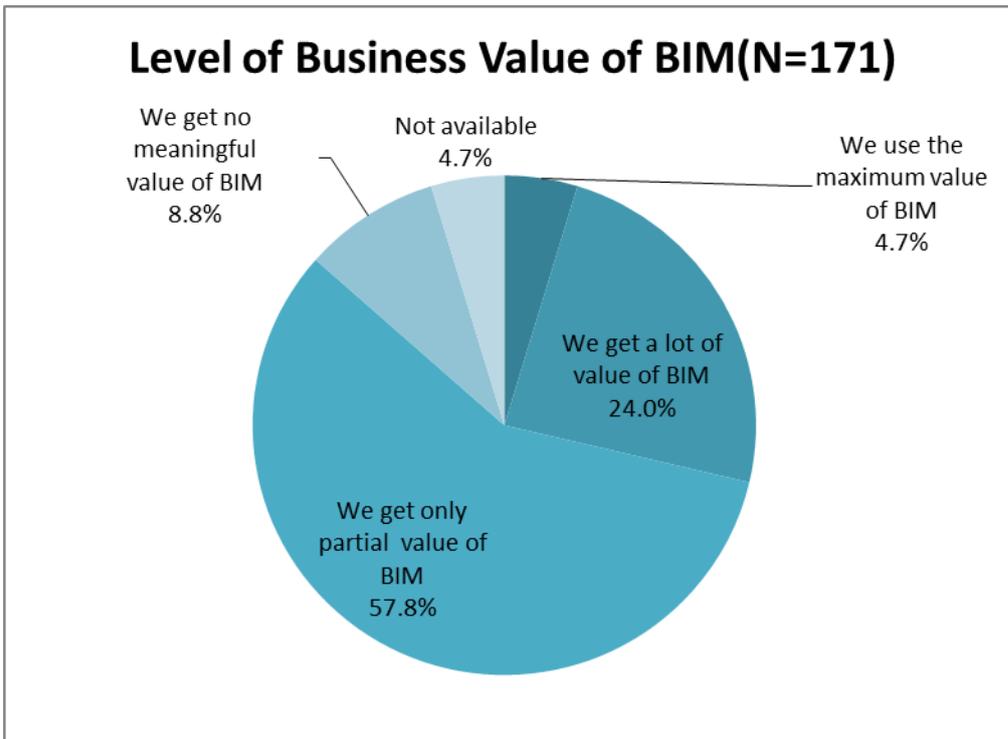
Value of BIM for structural designers and contractors is same level, and about half the respondents evaluated, "very high" or "high". On the other hand, the speciality contractors and building product manufacturers stays "very high" or "high" in 36.0% and 35.2%, respectively.

90% of BIM users make advantage

The question, "How much value of BIM does your office utilize?" were asked to the

respondents who introduced BIM in the office. The answer "We use the maximum value of BIM" is only 4.7%, then followed "We get a lot of value of BIM"(24%), "We get only partial value of BIM"(57.9%). About 90 percent of the office which introduced might make advantage of BIM.

From these results, it is understood that architects, engineers, contractors make some advantages by introducing BIM. The owner's advantage is not proven at this time because owner respondent is too few. We focus on advantage of BIM for architects and general contractors in following section.



Player Value of BIM / For Architects

Reduced Errors in Construction Documents in Architect's Offices

Communication Improved by Visualization of Design

To verify whether there is a difference in value of BIM architects and general contractors, the answer from 62 architects who introduced BIM in the office was separately investigated. As a result, it has been found that architects feel the value of BIM to enhance their productivity(ROI) by decreasing the errors in the construction documents and the design visualization.

Value of BIM for Architects

Answers of the answer of 62 respondents who work for BIM introduced architect's office were analyzed by three aspects of quantitative effect; the improvement of internal operations, the business improvement, and the productivity enhancements.

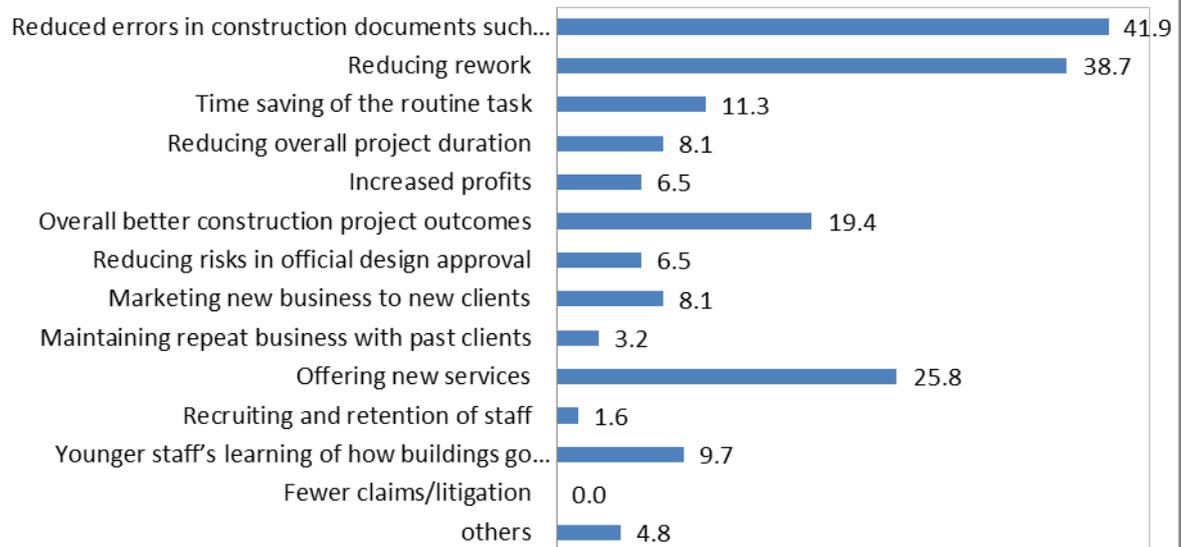
Among them, those who are in charge of "Architectural design" (66.1%) are the most. Then "Managers and executives" (22.6%) followed. Other occupational categories were very few, and less than 10 percent.

The top answers to the question, "Which part of internal operations has improved it by the BIM introduction?" are "Reduced errors in construction documents such as drawings" (41.9%) , which exceeded "Reducing rework" (38.7%).

It is an advantage of BIM that various drawings and the door and window schedules, etc. are automatically made from a single BIM model of the building while securing compatibility. Architects find the value of BIM mostly where their business improved by reduction of errors and rework.

Following answers are; "Offering new service" (25.8%), "Overall better construction project outcomes" (19.4%), "Time saving of the routine task" (11.3%), and "Younger staff's learning of how buildings go together is improved" (9.7%).

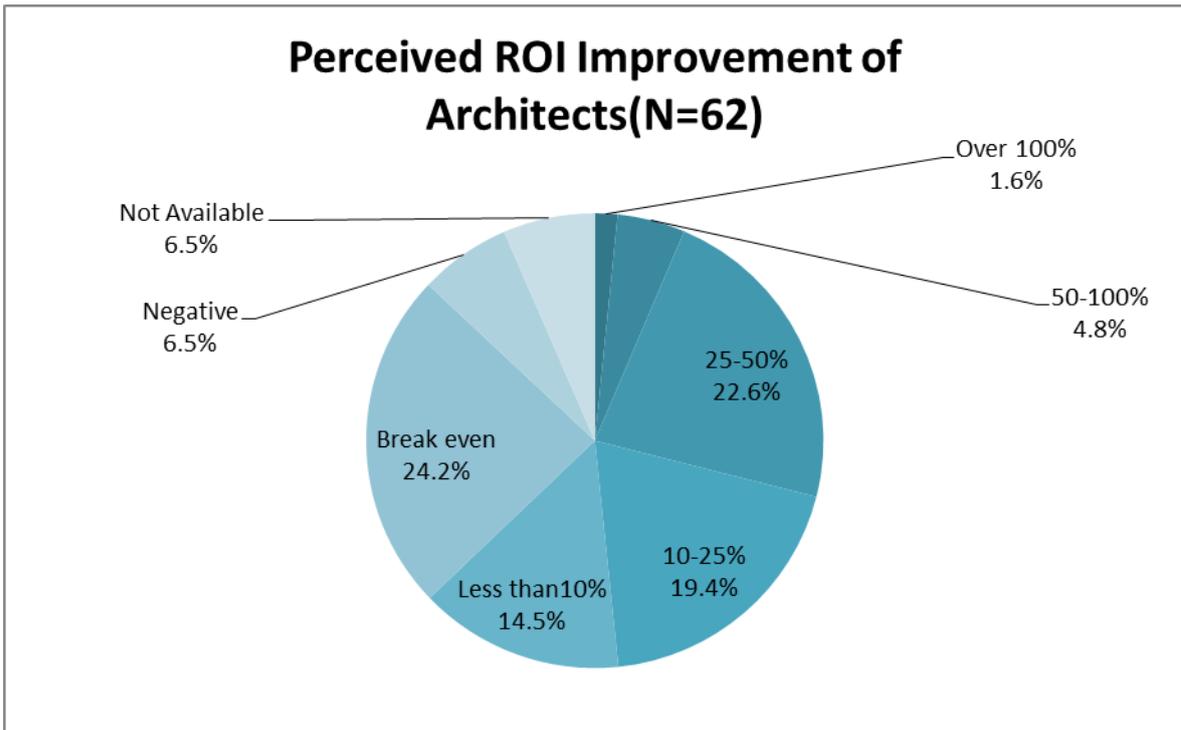
Most Important Internal Benefits for Architects (N=62)



Effect in Business Improvement Exceeds the Average

The answers to the question, "How much operating effectiveness has improved by introducing BIM? ("guess value" when the effect was not measured)" are; "100% or more" (1.6%), " 50 to 100% " (4.8%), and " 25 to 50% "(22.6%). Combining them, "25% or more" comes to nearly 30%.

Including "Less than 10%" (14.5%)" and "10 to 25%" (19.4%), about 2/3 of BIM introduced architects feel that operating effectiveness has improved more or less.



Productivity Improved by Design Visualization

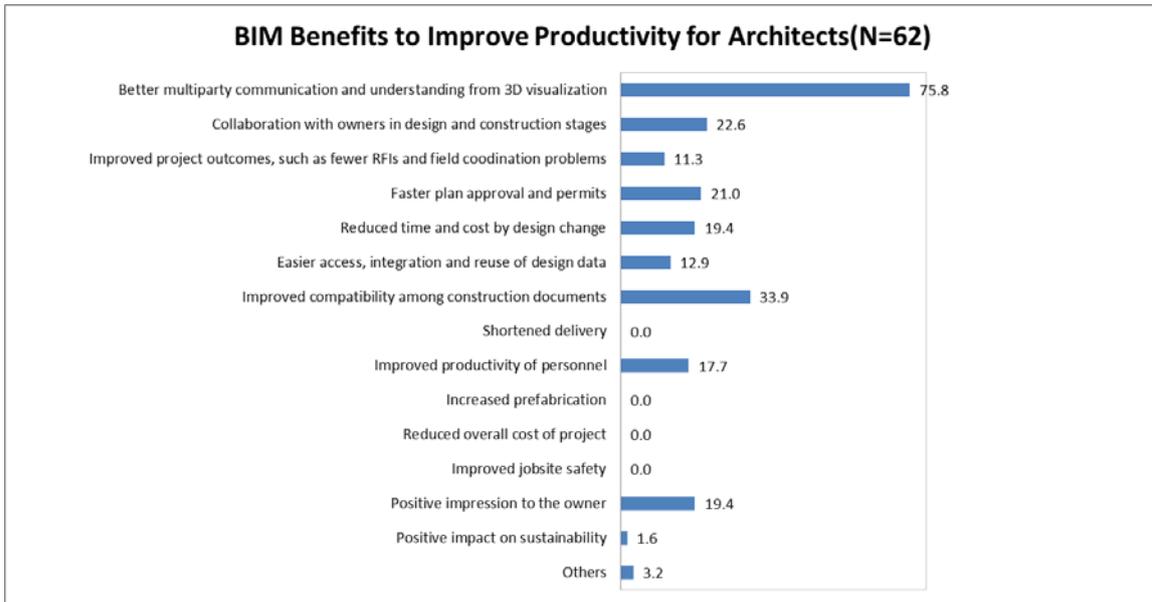
Top answer to the question, "What productivity enhanced by introducing BIM" is "Better multiparty communication and understanding from 3D visualization" (75.8%), which is much more than the second answer "Improved compatibility among construction documents" (33.9%).

In the improvement of internal operations, there were a lot of people who had enumerated reduction of errors in construction documents. However, architects seem that they evaluate more value of BIM in productivity improvement by communication with customers by design visualization, than reduction of errors.

The 3rd or latter answers are "Collaboration with owners in design and construction stages"(22.6%), "Faster plan approval and permits"(21%), "Reduced time and cost by design change"(19.4%) and "Positive impression to the owner" (19.4%), etc. These relate to the use of BIM as the communications tool with the customer.

On the other hand, architects do not show interests in the productivity improvement at the construction stage. Answers such as "Shortened delivery", "Increased prefabrication", "Lower project cost", "Improved jobsite safety" are none at all. This reflects that most architects hardly have to do with the BIM use at the construction stage It is interesting

where the difference with the construction company is.



Player Value of BIM / For General Contractors

General Contractors Find Productivity Improvement in Wide Field

More Value in Reducing Rework than Errors

Answers from 79 respondents of general contractors who use BIM in the office were investigated to see effects of the business improvement and productivity improvement by BIM. Although the overall tendency looked like architects, they evaluate productivity improvement in a wide range such as offering new services, marketing new business to new clients.

“Reducing Rework” is the Most Value of BIM

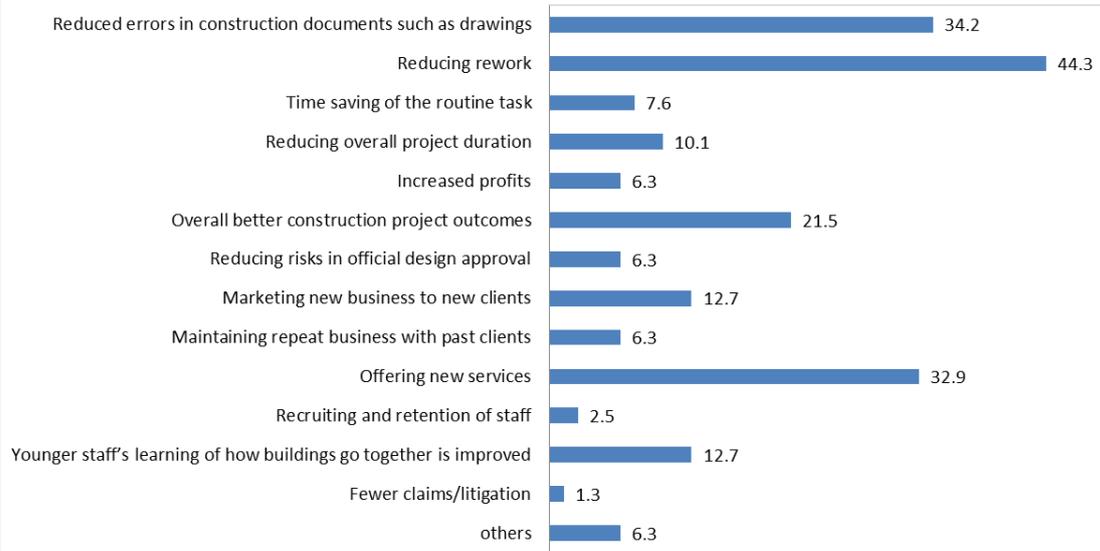
Among 171 respondents who had introduced BIM in the office, 79 people work for general contractors, who are more than architects in number (62 people). Their jobs are "Architectural design" (45.6%), "Manager / executive" (11.4%), and "Construction management" (10.1%). Compared to architects, the breakdown shows lower ratio of architectural design, and wider jobs are contained.

Top answer to the question, "Which part of internal operations has improved it by the BIM introduction?" is "Deducing rework" (44.3%), exceeding "Reduced errors in construction documents such as drawings" (34.2%). It shows that general contractors evaluate reducing rework higher than reduction of errors in documents. This is a difference from architects

Next top answers are “Offering new services”(32.9%) and “Overall better construction project outcomes”(21.5%). Though the order is same as architects, general contractors scores are higher than architects.

The value of BIM for internal business for general contractors is wider than that for architects, and contains various aspects in business.

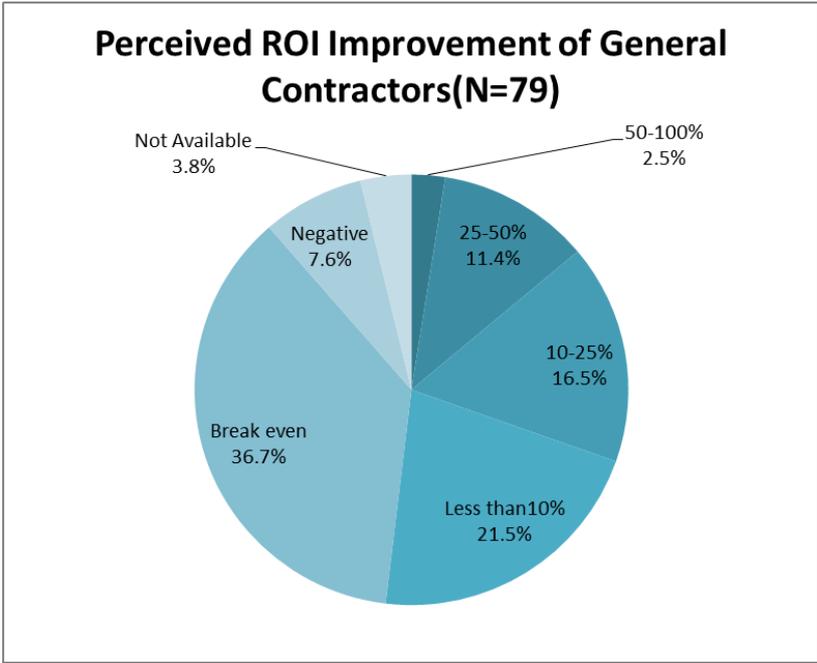
Most Important Internal Benefits for General Contractors(N=79)



Quantitative Effects in Business Improvement is lower than Average

The answers to the question, "How much operating effectiveness has improved by introducing BIM? ("guess value" when the effect was not measured)" are; "100% or more" (none), " 50 to 100% " (2.5%), and " 25 to 50% "(11.4%). Combining them, "25% or more" is only 13.9%. This score is relatively lower than overall average (25.7%).

Adding answers " less than 10%" (21.5%) and " 10 to 25% " (16.5%), 51.9% of respondents admit the effects for business improvement. But this score falls below overall average (60.2%).



Better Impression for General Contractors by BIM

Like architects, top answer to the question, "What productivity enhanced by introducing BIM" is "Better multiparty communication and understanding from 3D visualization" (78.5%). But the second answer is "Positive impression to the owner" (39.2%), exceeding "Improved compatibility among construction documents" (36.7%). Then "Collaboration with owners in design and construction stages" (31.6%) follows.

For general contractors, BIM is thought to be a very effective tool for building "Positive impression" or "Better relationships" to clients, which is main resource to improve productivity. Scores for other effects in construction stage such as "Improved project outcomes, such as fewer RFIs and field coordination problems" are generally higher than architects.

BIM Benefits to Improve Productivity for General Contractors (N=79)



Difference in BIM Usage Between US and Japan

Comparison with McGraw-Hill Construction's BIM Report

The McGraw-Hill-Construction conducted a BIM Internet survey to personnel in AEC industry in North America from May 28th to July 2nd, 2009. The results are issued in the report "THE BUSINESS VALUE OF BIM". We investigated difference and similarity of BIM usage in US and Japan from results which are comparable, and interviewed Mr. Jay Bhatt, Senior Vice President of Autodesk Inc., Architecture, Engineering and Construction Solutions, as a major BIM vendor.

--- How do you think about differences and similarity of BIM use in the US and Japan?

Mr. Bhatt There are more similarities between our two markets than differences. For example practitioners in both countries understand that it's the information derived from a BIM model that is becoming more and more important and is seen as the real value.

While some companies are in the evolution phase of implementing BIM in their basic workflow, many companies understand the added value of analysis, simulation, visualization, and collaboration that BIM provides to the design and building process.

Awareness for BIM has increased in building industry, yet similar to the United States, there is still limited awareness at the owner level. Another similarity is that BIM is emerging as a process not just for new design and construction but also for building renovation and retrofits, which is where much of the growth within the building industry will come from in the future.

One difference between the markets that Japan is extremely consolidated and the top general contractors are driving a large part of the construction industry. These companies are design build companies which is not a typical project delivery method in the United States.

---How is Autodesk planning to supply BIM products for Japanese users as a major BIM vendor?

Mr. Bhatt The Japanese Market is one of the most interesting markets globally for

building. We currently have a number of BIM products in Japan such as Autodesk Revit Architecture. We will also expand our supply to the Japanese market by leveraging our large partner community which helps us with the local requirements; adapting our products to fit the Japanese market.

Another interesting point is that because Japan is one of the most seismic countries in the world we are working to integrate Revit with leading analysis software.

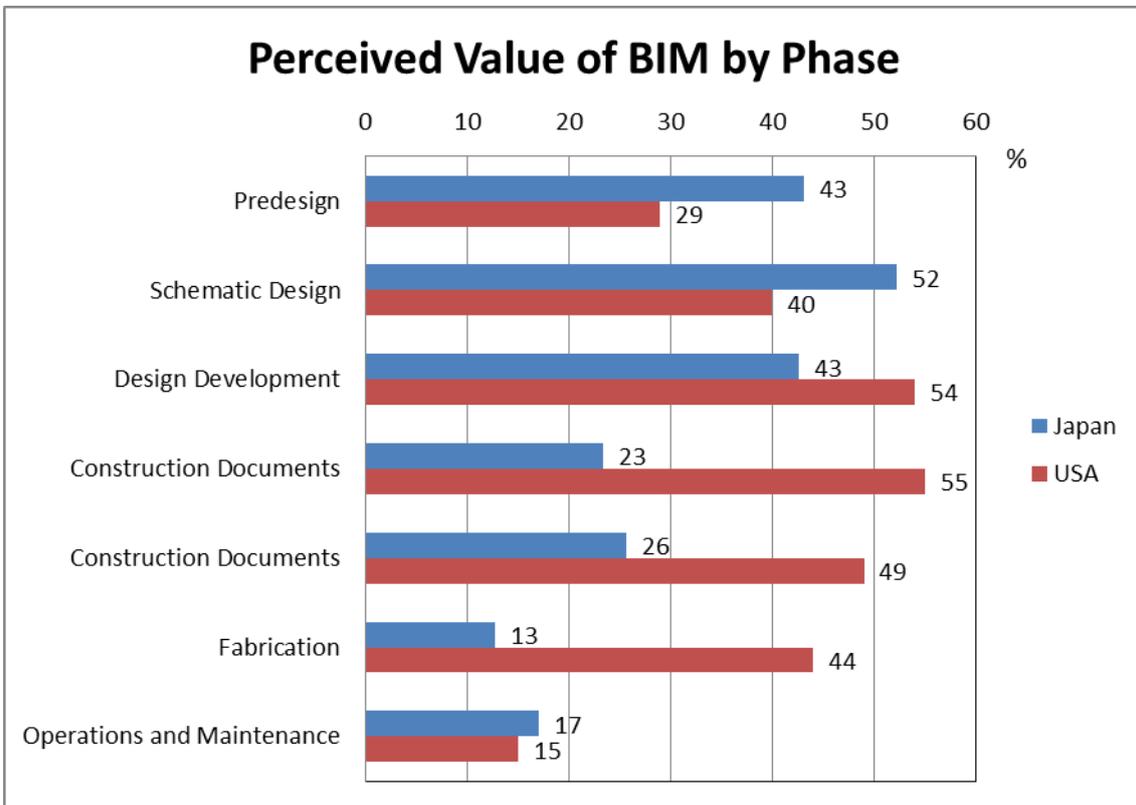
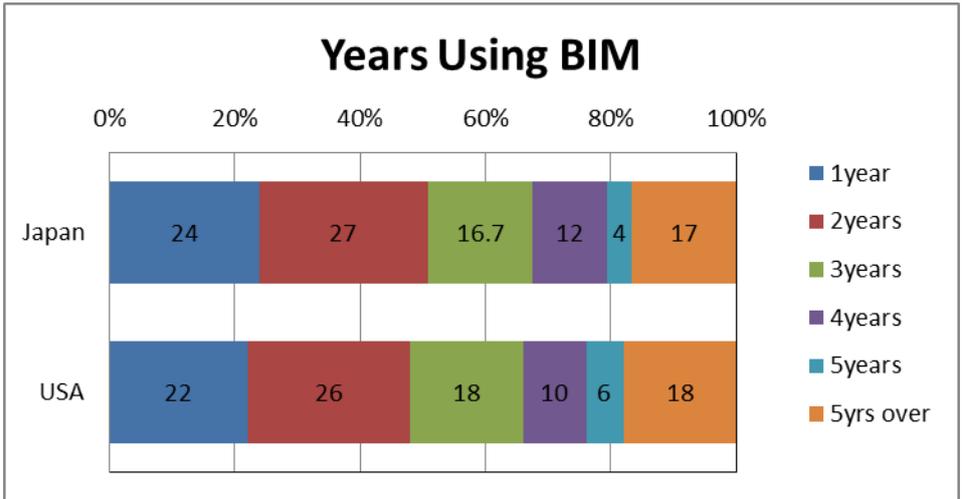
We are striving to improve the environmental performance of buildings. Autodesk and the Japan Sustainable Building Consortium (JSBC) announced a partnership in early 2010 to integrating the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE) with BIM.

The partnership helps verify the compatibility of CASBEE and BIM, based on Autodesk Revit Architecture, and then develop collaborative tools. This allows designers to use BIM for efficient and precise design, analysis and graphics production and to use visual considerations when determining the environmental performance of buildings. Customers in Japan will now have support for comprehensive management of a building's life cycle workflow and increase the sustainability of their designs.

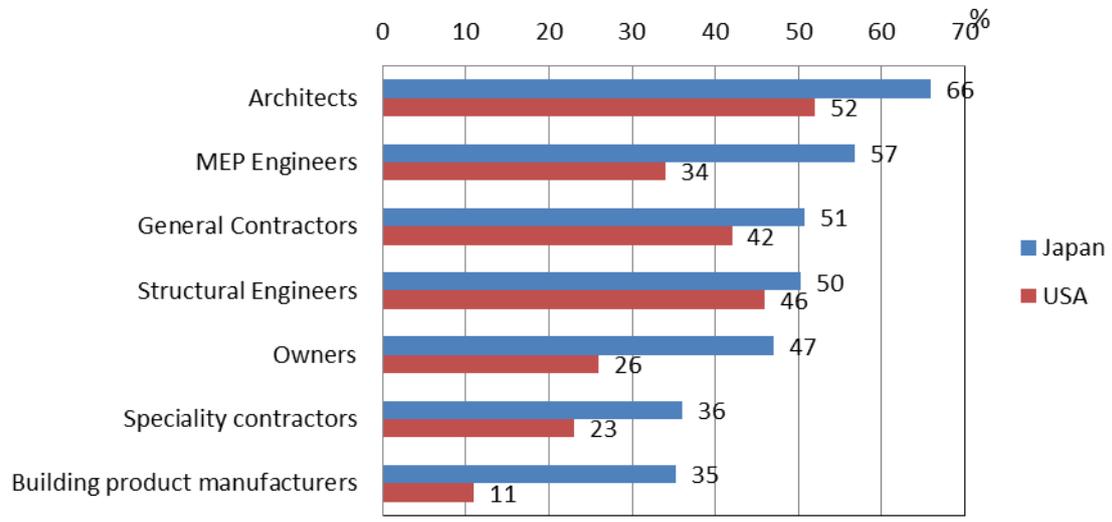
---How can Japanese AEC industries utilize BIM for expanding international projects?

Mr. Bhatt Today many firms have locations throughout the globe. BIM provides an ideal platform for these geographically distributed multi-disciplinary teams to work.

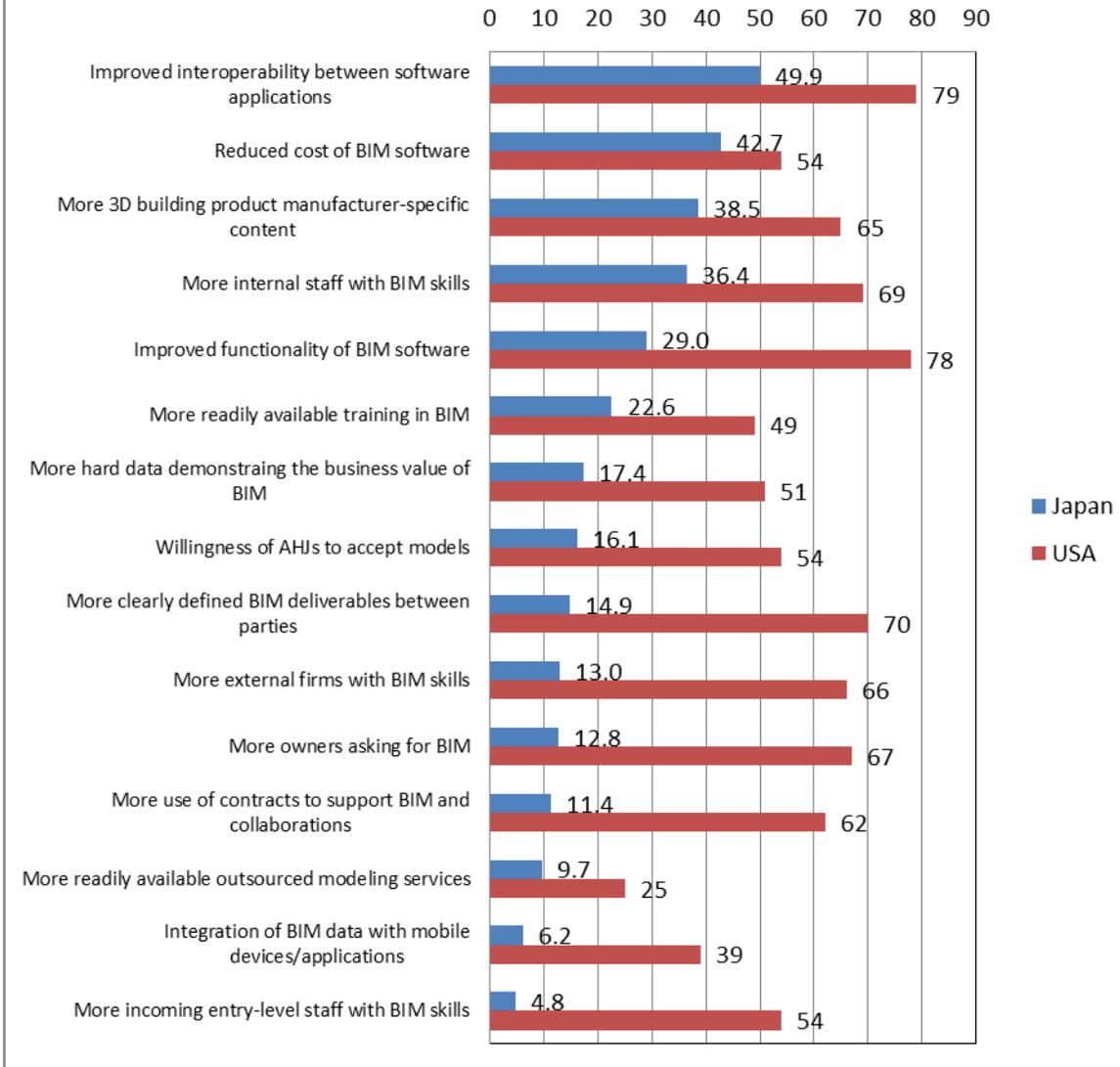
The BIM model is superseding DWG files and a phone conversation as the preferred method of communication and collaboration for a project team, as it carries the design intent and time sequencing of the building. The entire team can see exactly how the building will be designed, constructed and operated.

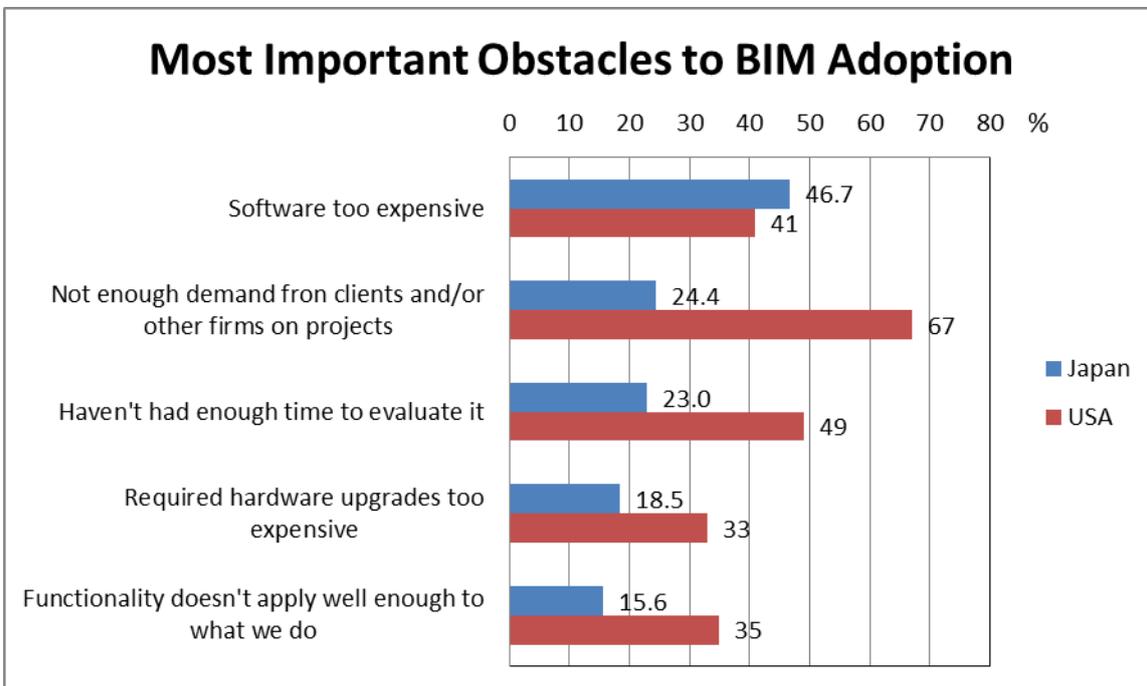
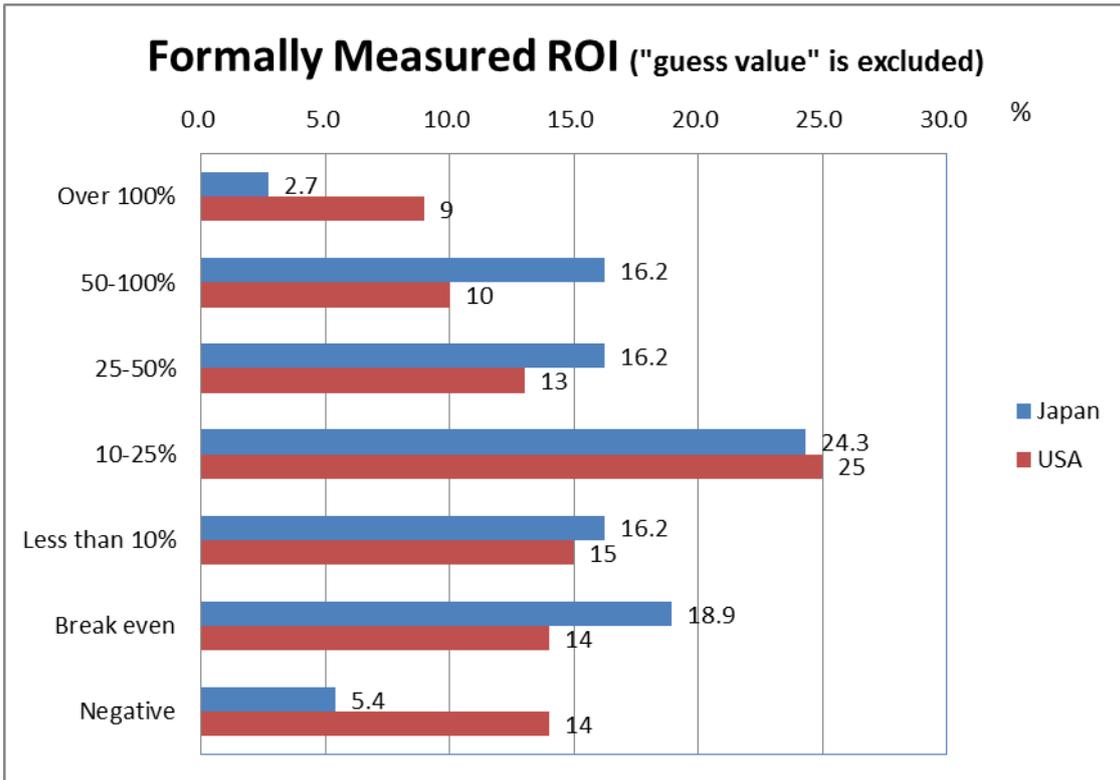


Project Participants Who are Perceived to Experience the Most Value (Very High/High)



Top Ways to Improve Value of BIM





Case Study 5 : Supply Chain Management by BIM

Design and Overseas Production of Custom-Designed Furniture by BIM

Paperless Studio Japan

Paperless studio Japan in Fukuoka City uses 3D CAD for BIM to design furniture custom-designed for the building, modeling even the thin veneer to cover the surface and one machine screw. Furniture is manufactured at some domestic and foreign factories according to the drawings, CG perspective, and the material lists made from BIM models. The number of furniture parts counts more than 1000 items in a big project. Design, delivery, and installation in the construction sites is controlled by a database using property information of BIM models, realizing "Supply Chain Management" by BIM.

Submitting Drawings and CG by BIM, Order to Overseas Factory

Paperless studio Japan in Fukuoka City is running various businesses that support the use of BIM, such as design support/detail design by BIM, and the network server environment construction.

Among them, there is a service called "Support for BIM synchronized overseas parts procurement". It helps customers to manufacture custom-designed furniture and modular bath, etc., specially designed for the building at factory in China or other countries based on drawings and CG perspective cut out from the BIM model. Their service includes import and installation of the furniture in the construction site.

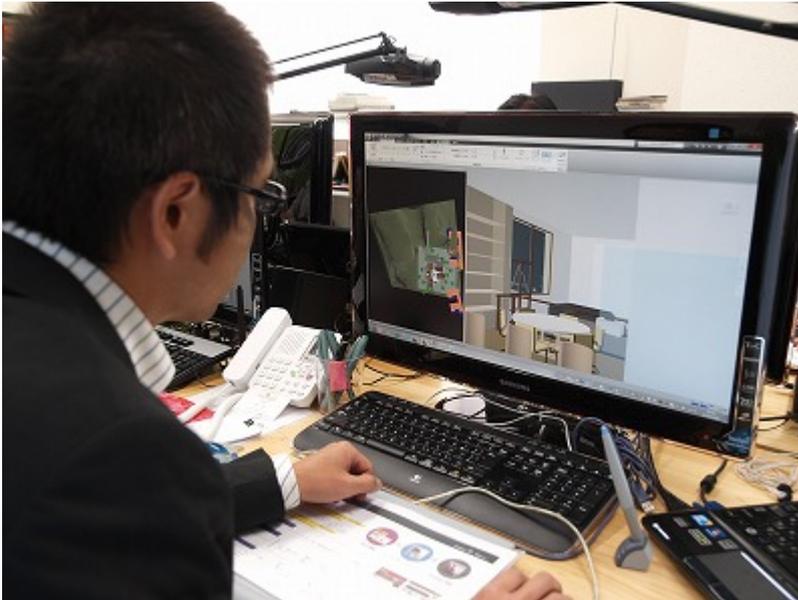
"I used to worked for a furniture manufacturer before. Because we used 2D drawings to order furniture to overseas factories, there was blur in understanding detail design, and we could not get what we had thought. Then we introduced BIM and used CG perspective with the drawings in ordering. After that, troubles decreased sharply" says Mr. Takayuki Katsume, president of Paperless Studio Japan.

"For instance, even thin melamine resin board and machine screws that installs legs to the table , etc. are modeled in detail by BIM. We make drawings, CG perspective for important portion from the BIM model and used them for order."(Mr. Katsume)

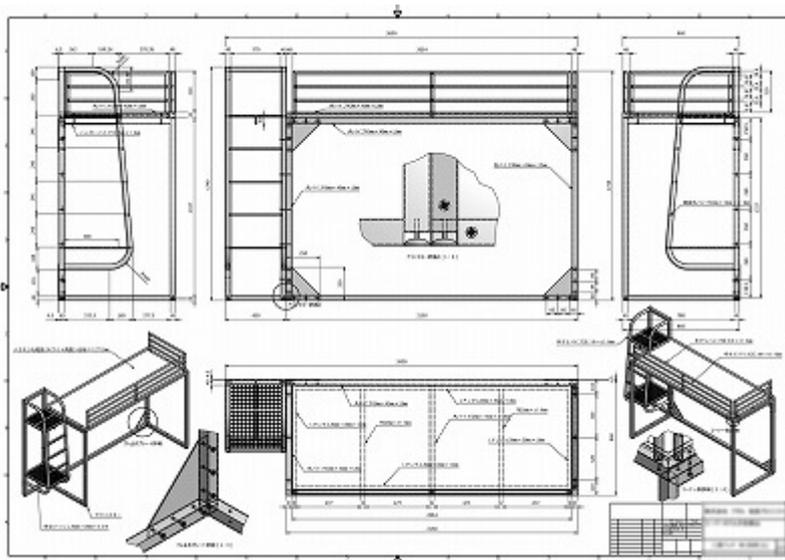
As Paperless Studio Japan send conventional 2D drawings and perspective to overseas

factories, it is possible to communicate with them precisely even if they do not have BIM software.

“CG perspective shows the points of the final inspection on the product. In other words, if the products do not meet CG, we do not receive them. Compared to sending BIM model data itself, errors hardly occur because check points are clearly shown.”(Mr. Katsume)



Design work of furniture using 3D CAD for BIM.(Photo: Ryota Ieiri)



Drawing which shows even machine screws (Following images: Paperless Studio Japan)



CG image attached to drawings



Furniture manufactured at an overseas factory

Supply Chain Management by Property Information of BIM Model

Normal 3D CAD which does not have BIM functions, could be used to just make drawings and CG perspective. However, there is another reason why they introduced 3D CAD for BIM. They manage factories and production progress by a database system that

uses "Property Information" embedded in BIM models.

The furniture installed in the building sometimes counts more than 1000 items if it is classified by type, color, and size, etc. when the project is big. In addition, because these items are composed by some parts, the total number of parts that should be managed is multiplied several times. The entire volume of these parts becomes 20 or 30 16-foot size containers.

They sometimes order parts for a single furniture to Kagoshima for stainless parts, Osaka for iron members, to China for wood part separately. It would be very cumbersome work to manage information of factories, manufacture progress, and cost, etc. by spreadsheet. They cooperate property information of BIM model with database software, making the process control efficient.

"This database has been working on a stand alone PC. But we are developing a "cloud computing" system so that we could access it from anywhere on the Internet. Using this system, overseas factories can input the progress situation of production by themselves. We can manage production information in real time.", Mr. Katsume says.

It could be called a "Supply Chain Management" system by BIM. Overseas production by this method can be applied to not only furniture but also the main members of buildings. In a word, it pushes Japanese AEC industry to overseas projects by BIM.

One Stop Service by 3 Companies in a Building

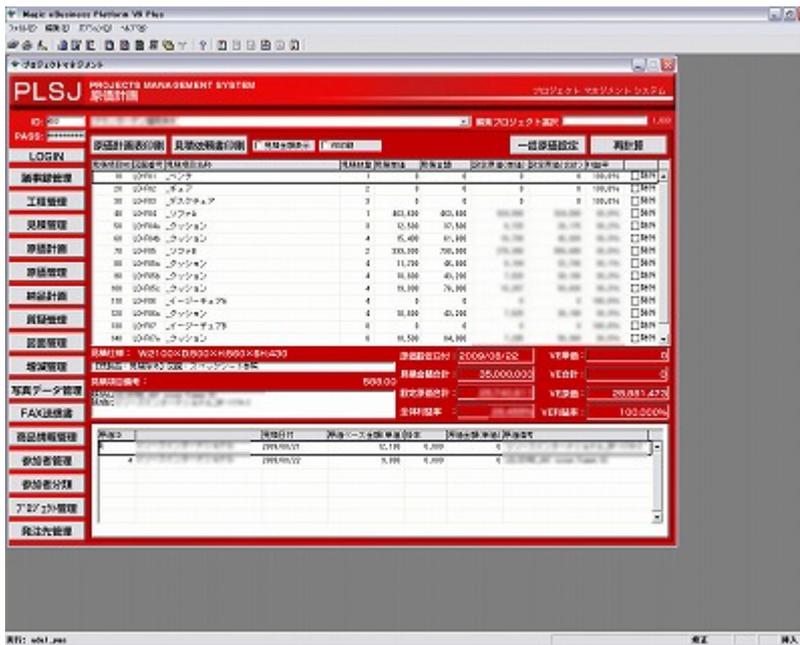
Paperless Studio Japan shares a building with two other BIM related companies. IAED is an architects' office which mainly design residential houses in China. VEC runs temporary employment agency for BIM users, BIM software training, and support for management at construction sites.

VEC concentrates on the software classes that train BIM users. They teach students not only the usage of the BIM software but also know-how in construction sites. Therefore, student can work as a dispatch staff of the design and the construction management just after the training finishes.

When VEC needs overseas production of furniture in their construction sites, Paperless Studio Japan makes support VEC making production drawings with BIM, manufacturing and delivering of furniture. One stop service of BIM by three companies is supplied there.



Installation work of furniture at a construction site in Japan



Project management system using property information of BIM models



Office room which is shared by Paperless Studio Japan and IAED (following 2 Photos: Ryota Ieiri)



BIM software training class run by VEC

Conclusion

BIM Opens the Door of AEC Industry to the Future

Indispensable Strategic Tool to Improve Design and Productivity

AS BIM is a system that can express not only 3D shape and dimension of buildings but also information on the design and construction, it is greatly different from normal 3D design tool. Many people in AEC industry have started introducing BIM as a tool that improves the corporate competitiveness because it can be used for CG and perspective, as well as drawings, analysis, simulation, management, operation and maintenance. It is certain that this trend will accelerate more and more in the future.

“2009 was First BIM Year in Japan” was Verified by Data

It has been whispered among people in AEC industry that “2009 was First BIM year of Japan”. This BIM survey results verified that it is true. Because half of respondents answered that they introduced BIM after 2008. 2009 was most of all.

BIM usage in foreign countries has been attracting attention in Japanese for several years. Japanese companies had been carefully examining whether it was usable in Japanese AEC industry and by themselves. They finally turned to introduce BIM in full-scale. It was 2009.

Though there were some “3D Booms” in the past, the movements went out of fashion in a short-term upsurge. However, this BIM boom is different from the past. It is becoming a big current. The reason is that BIM is understood not as an individual design tool but as a organized tool that improves the productivity of the entire construction process, from design and construction to operation and maintenance.

BIM Demonstrates Effects Shortly after Introduction

The usability of software and hardness has improved more greatly than before. It might be seemed that BIM is very difficult for the designer who has treated only the drawing 2D drawings, because it designs buildings by 3D model.

However, it is a misunderstanding. In the survey, respondents stated reasons for most important obstacles to BIM adoption as "Software too expensive", "Not enough demand

from clients", and "Haven't had sufficient time to evaluate it".

On the other hand, 70 percent or more respondents answered that their business efficiency had been improved by BIM though many of them had introduced BIM in only 1-2years. It would show that BIM demonstrated some effects shortly after they introduction.

More than 80% of respondents enumerated "Presentation of the architectural design" as purpose to use BIM. Beginner companies might be enjoying effects of BIM by design presentation using 3D perspective or walkthrough to their clients who have difficulty in understanding design by 2D drawings.

More than 90% of respondents who introduced BIM in the office expect that the project that uses BIM increases further in two years.

The result of the survey also shows that the gap of BIM literacy is rapidly growing between users and .non-users.

Value of BIM Differs between Architects and General Contractors

As the number of the architect's office and general contractors that use BIM on business increases, value of BIM begins to differ by the type of business and the occupation

General value of BIM is understood to manage various information of construction process from upstream to downstream, from design to construction, maintenance, in a single BIM model, which prevents inefficiency such as post mistakes, rework, repeated data input. And "Front loading" effects improve productivity of construction projects by solving problems in downstream stages in advance.

However, the "wall" between professionals in design stage and construction stage is still higher than it is thought. To make "Front-loading" work, new rules should be established to evaluate design fee sharing labors and costs between designers and contractors.

Architects are not Interested in Productivity Improvement in Construction Stage

Architects pointed out that "improvement of communication and understanding by 3D visualization", "improvement of compatibility between design documents", and " collaboration with the owner in design and construction stage" are important elements

to improve productivity.

The survey also revealed that they were indifferent to elements in construction stage such as “reducing overall project duration”, “increased prefabrication”, “reducing overall cost of project”, and “improved jobsite safety”.

On the other hand, some design companies which has drawn drawings as sub-contractor of general contractor are beginning to undertake design works from planning stage to detail design using know-how of construction stage. In this case, their detail drawings can be used for construction work without modification at sites. That would make new value.

If such “workable drawings” are highly evaluated by contractors, the drawings would be bought at higher price, making change of design fee. Then architects might be interested in productivity at construction stage.

General Contractors Aim Productivity Improvement by “Supply Chain Management”

General Contractors pointed out similar value of BIM to architects. However, it was a big difference from architects that they pointed out every element of BIM, including construction stage, was effective to improve productivity.

In a construction project, the cost in construction stage is much larger than that in design stage. Therefore, general contractors should improve productivity by ordering materials at proper time, quick decision making for specification and drawings, and project management, which are different problems from architects. In other words, it is productivity improvement by "supply chain management" with BIM.

Especially for design-build projects, it is possible to improve cost and delivery time by “front loading” in design stage such as clash detection, using know-how for construction stage. In this case, information of project could be managed by single BIM model from upstream to downstream, which is basic value of BIM.

BIM is Indispensable for Overseas Projects and New Business

Though Japanese construction market are shrinking every year, there are a lot of construction markets when we turn our eyes to foreign countries. Visualization of design and construction procedure by BIM can greatly omit the explanation in foreign languages. Therefore, if designers and engineers are not good at foreign languages, it would be

easy for them to explain about design and structure to foreign owners using BIM.

BIM model data made by BIM software used worldwide is easily exchanged by E-mail or other ways. The method that Paperless Studio Japan designs furniture in Japan, and produces it at the foreign factory could be applied also to the main portion of buildings such as columns, beams, and floor slabs.

BIM is not only design tool but also a strategic tool that can strengthen competitiveness of Japanese AEC industry through design visualization, data exchange, and combined information management. It is indispensable to open the door of the construction industry to the future.

Profile of Respondents and Outline of BIM Survey

How BIM User's Survey was Conducted

517 respondents answered, 1/3 of which were BIM Users

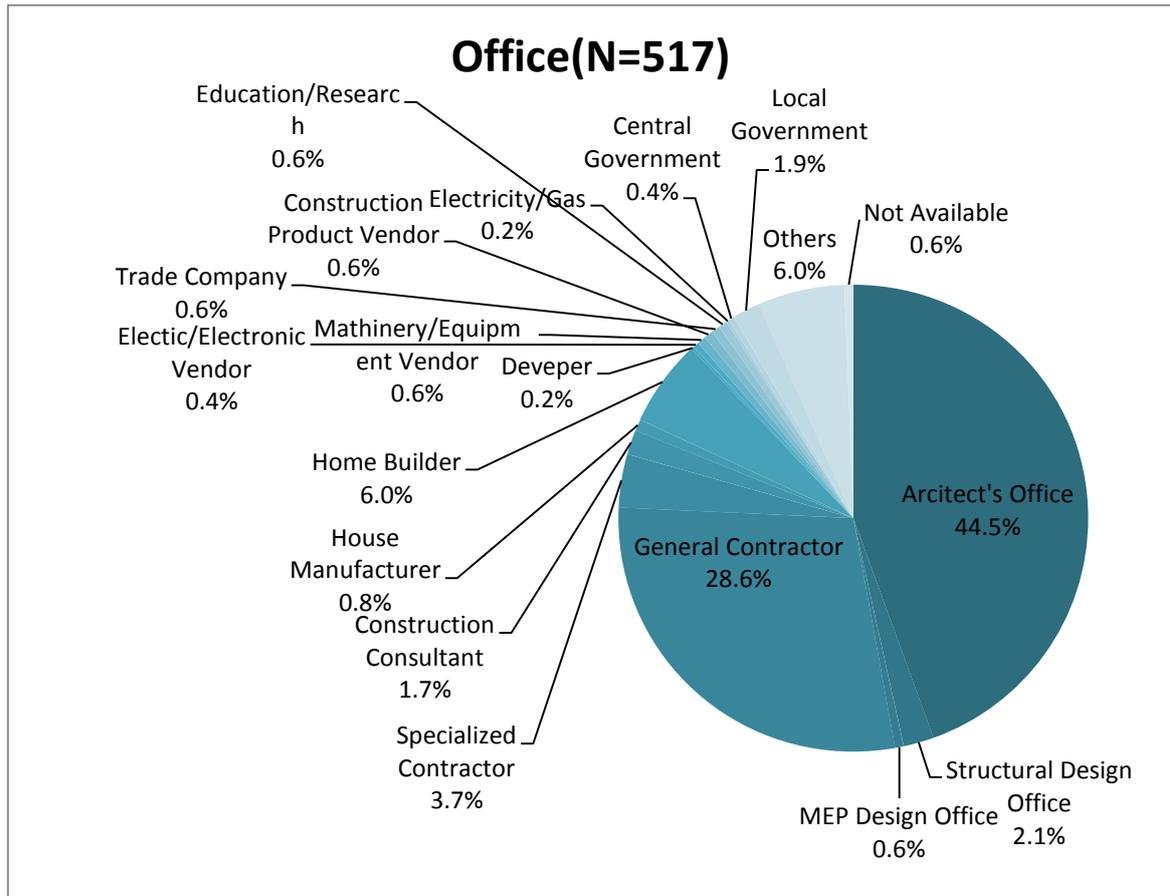
Answers from 79 respondents of general contractors who use BIM in the office were investigated to see effects of the business improvement and productivity improvement by BIM. Although the overall tendency looked like architects, they evaluate productivity improvement in a wide range such as offering new services, marketing new business to new clients.

Nikkei BP Consulting, Inc. and Nikkei Business Publications, Inc.'s "KEN-Platz" web-site, which is specialized for AEC industry, conducted the "BIM Utilization Survey" from September 27th to October 6th, 2010 in order to reveal how BIM is used in Japan. 517 people in total answered, and 1/3 of them used BIM by themselves.

---Office

About half of respondents work for companies engaged in architectural design. Breakdown is; architect offices (44.5%), structural design offices (2.1%) and MEP design offices (0.6%).

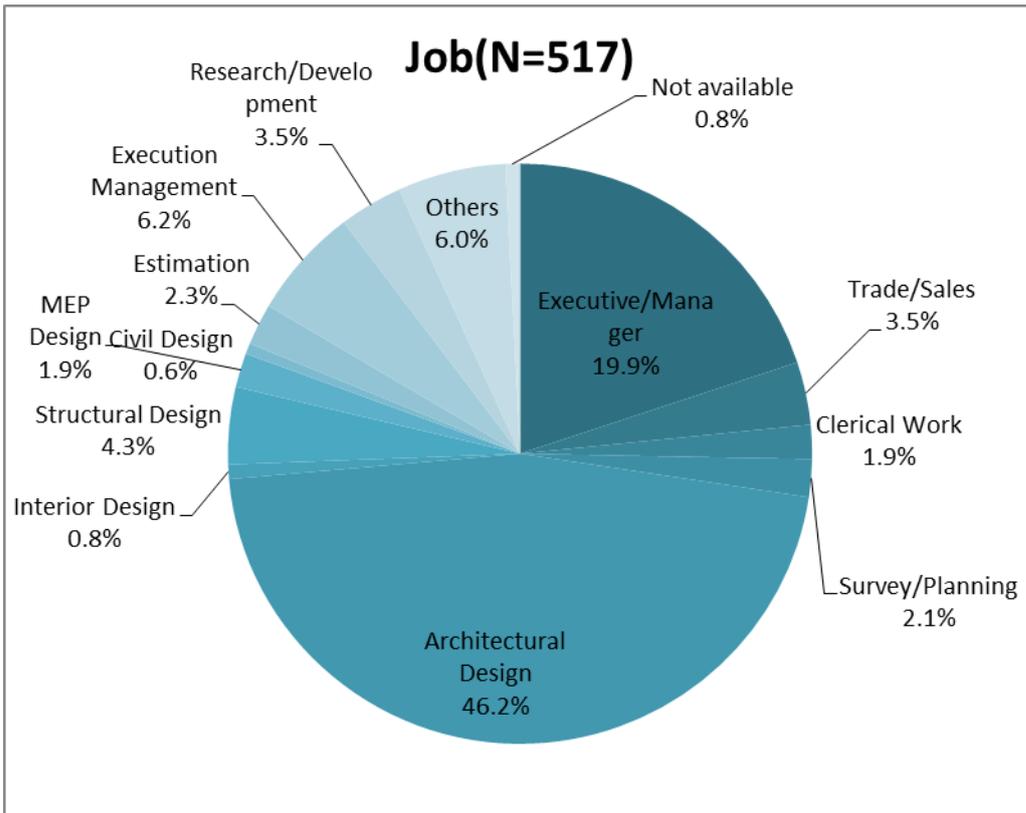
Respondents of general contractors were 28.6% and specialized contractors were 3.7%, total number occupied about 1/3. Rest 20% was occupied by home builders(6.0%), local governments (1.9%), and design consultants (1.7%).



---Job

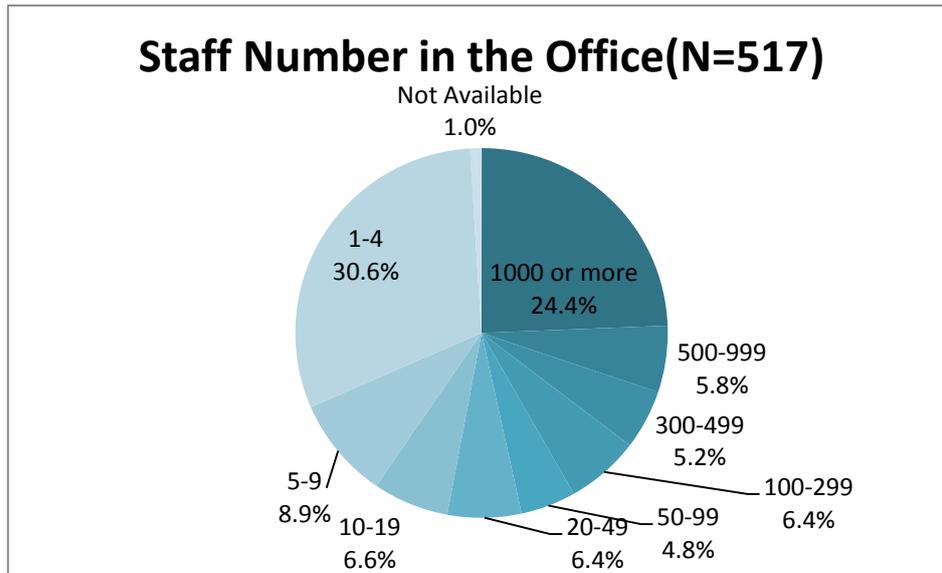
More than half of respondents had jobs in design stage. Breakdown is; architectural design (46.2%), structural design (4.3%), MEP design(1.9%), and interior design (0.8%). Concerning construction stage, execution management (6.2%) was included.

Other respondents were; executive / management(19.9%)、trade /sales (3.5%), and clerical work (1.9%), etc. These jobs occupied about 1/4. Respondents included designers who were interested in BIM, and top executives who were considering about BIM introduction as strategic tool.



---Number of Staff in Respondents' office

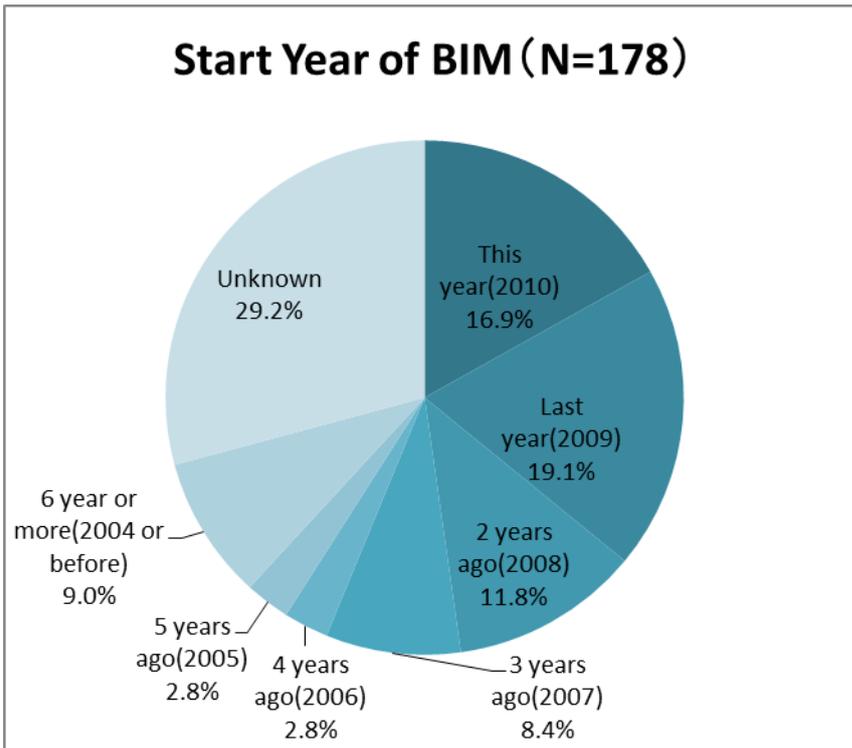
Respondents' office staff number were; "1-4" (30.6%) and "1000 or more" (24.4%). This means that respondents who work for very small companies and very big companies were dominant. About half of respondents work for companies of 19 staff or less. It looks the concern for BIM high in major companies with large organizational strength, and the private offices or small firms with light footwork. On the other hand, it was felt that medium scale companies were late for catching up BIM from the distribution of respondents.



---BIM Career

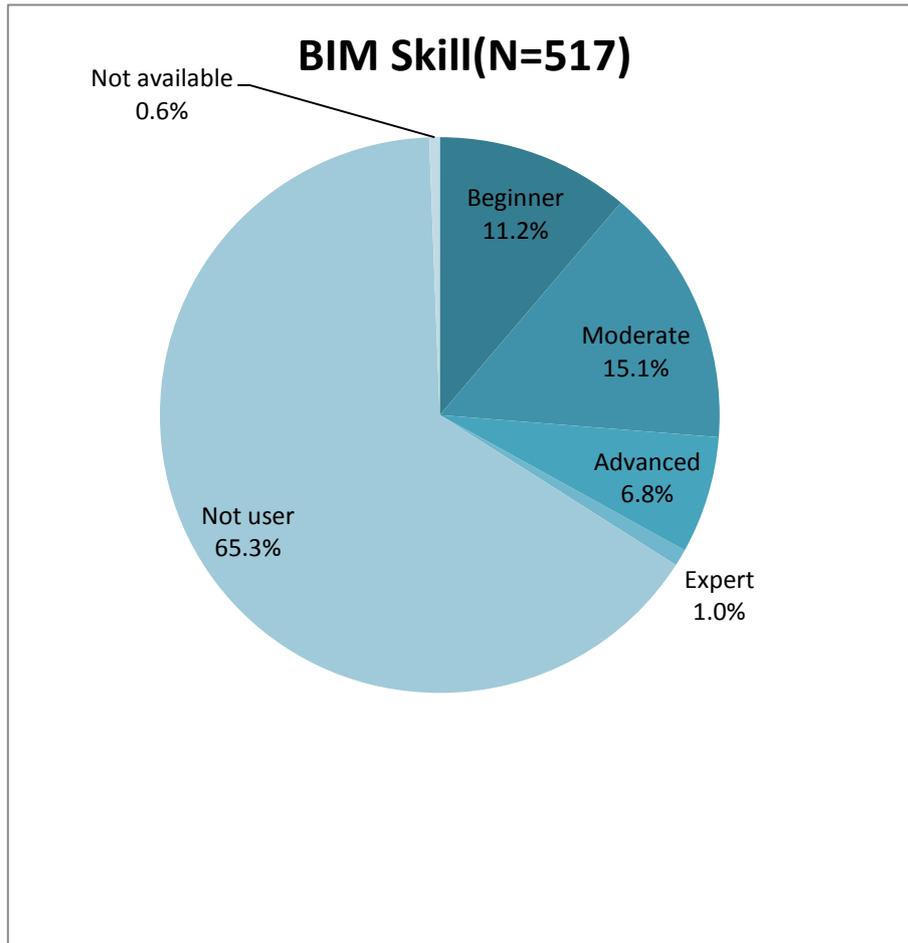
Respondents were composed by “BIM users” (34.4%) and “Non BIM users” (65.6%).

Among 178 BIM users, starting year of BIM use was “this year(2010)”(16.9%), “Last year (2009)”(19.1%), “2 years ago(2008)”(11.8%). More than half were up to 3 years. More than 10% had begun to use BIM before the word “BIM” became popular.



---Skill Level of BIM

517 respondents were composed by "beginner"(11.2%), "moderate"(15.1%), "Advanced"(6.8%), and "Expert"(1.0). About 2/3 of the respondent did not use BIM. As for result of this survey, view of non-users was strongly reflected for questions asked to all, and that of beginner or moderate BIM users was strongly reflected for questions asked to users.



(Explanatory notes)

Beginner: Just began to use BIM, and cannot use it without assistance

Moderate: Can use BIM for themselves while referring to the manual etc.

Advanced: Can do anything what they want. Teach other people.

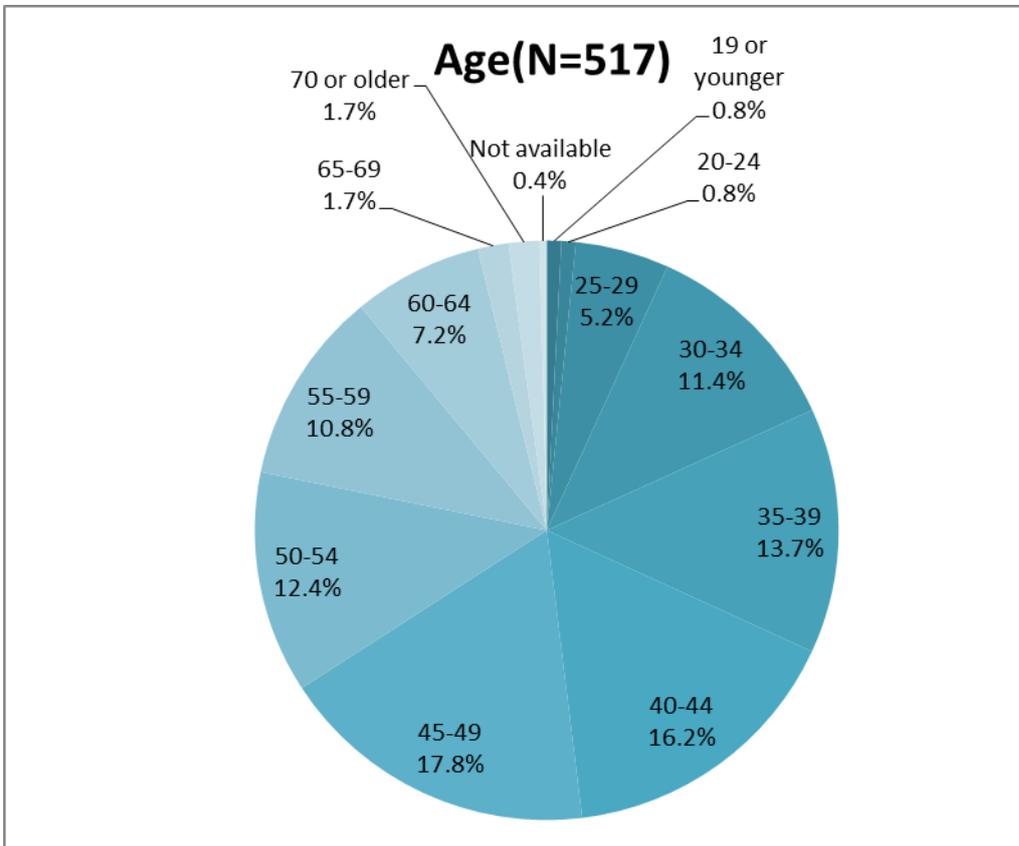
Expert: Can write codes of programs for themselves.

--Age group

More than half of respondents were from late 30's to late 40's. 50's or older respondents occupied 1/3 of all. On the other hand, 34 or younger respondents were less than 20% in

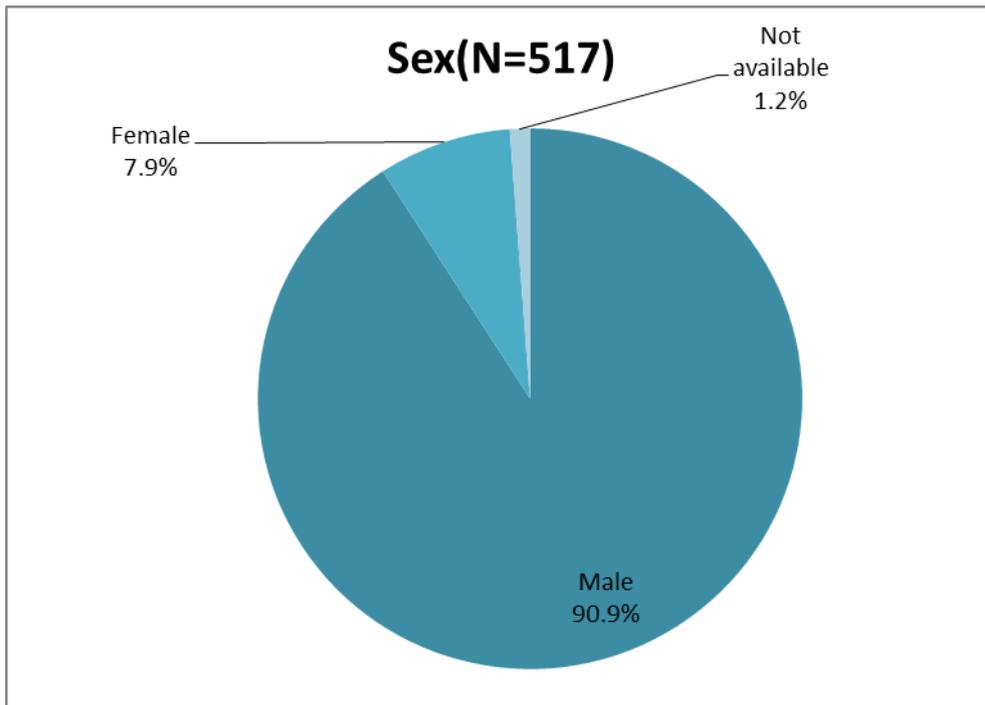
total.

It shows that business persons in their prime and their bosses, executives/managers, were strongly interested in BIM.



---Sex

Men were 90.9%, and women were 7.9%. The ratio of women would become higher for CAD operators. However, BIM is recognized not only a tool for drafting, but also a design tool for designers and engineers. BIM is also expected as a management tool by which the productivity improvement in design and construction business is realized. Therefore, the ratio of men who belong to this layer became higher.



<Survey Methodology>

Survey name: BIM (Building Information Modeling) Usage Survey

Survey period: September 27th to October 6th, 2010

Survey procedure: Through Internet

Object of Survey: Designers, engineers and other persons. who work for organizations related to AEC industry such as architects, contractors, and government and municipal officials.

Notification method: “KEN-Platz” website and E-mail to its members, website of cooperation organizations, Twitter, etc.

Number of valid responses: 517

Research agencies: Nikkei BP consulting, Inc. and “KEN-Platz” website

Survey Cooperation: Architectural Institute of Japan, The Japan Institute of Architects, IAI Japan, Revit User Group Japan, BIM software vendors, Ieiri-Lab. (in random order)

Case Cooperation: Ministry of Land, Infrastructure, Transport and Tourism(MLIT), Azusa Sekkei, NTT Facilities, Inc., Konoike Construction Co., Ltd, Shimizu Corporation, Taisei Cooperation, Toshiba Elevator and Building Systems Corporation, Paperless Studio Japan, Yasui Architects and Engineers (in random order)

<Reference>

3D CAD Usage Survey in 2007

Survey name: 3D CAD Usage Survey in Building Industry

Object of Survey: “KEN-Platz” website readers

Survey period: July 30th to August 10th, 2007

Number of valid responses: 172

3D CAD Usage Survey in 2008

Survey name: 3D CAD Usage Survey in Building Industry 2008

Object of Survey: “KEN-Platz” website readers

Survey period: July 28th to August 8th, 2008

Number of valid responses: 283

BIM Usage Survey Report 2011 version

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