DNA De nieuwe aanpak

A practical approach to integrated designing and building

Sustainable building is not just making use of a "passive house" or an "active house" concept, it is an integrated approach to designing and building. Building sustainably has consequences for the entire lifecycle of the project. Not only the multidisciplinary techniques, but also the integrated commercial side and integrated information exchange need to be in order. IPD Integrated Design and Project Delivery is the answer to a sustainable future.

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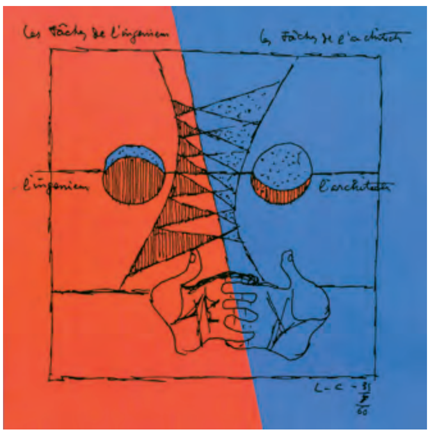
Summary

Chapter 1 Introduction

Sustainable building has become a team sport in which the most optimal form is sought in the areas of technology, exploitation and operational management. Sustainability is not an airy-fairy story from an idealist, but a combination of comfort, ecological materials, participation, efficiency, flexibility, design, etc. In other words: buildings developed using a sustainable approach are nice places to be, now and in the future. To achieve this, it is essential that the client, the design team and the implementation team collaborate. The approach to building shifts from building in series to serially developing individual projects.



1. Introduction

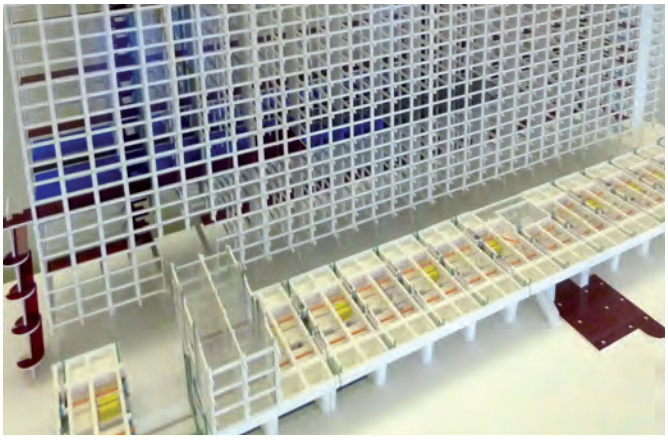
1.1 Why integrated designing?

Has building become complex? Or have we separated the skills and are we all individually responsible for a subtopic? Or do we have to return to the concept of the master builder who travelled from cathedral to cathedral making each subsequent building more beautiful and grander than the one before?
A building project involves many parties because of far-reaching specialisation in the building sector. It is no longer possible for the architect to master all facets of the job. Therefore, we can no longer expect him to satisfy all of the requirements we set.
Requirements that can sometimes be contradictory. And yes, it must also be sustainable...
Building sustainably requires the different parts of the building to interact extremely well to ensure increased comfort, energy savings, financeability and so on.
The design playing field has always been large, but architects are being increasingly trained as specialists. Sustainable building is only possible if a methodical method is followed and not when the architect acts as a form of Black Box with the output being the design. However, most architects have been taught by teachers who are freethinkers, utopianists and/or orderly anarchists. There is therefore a dichotomy.

Prior to the Second World War, an architect could oversee an entire project. Le Corbusier, for instance, is a good example of an engineer/architect who knew how to design and build integrated projects. In 1928, he and some friends established the CIAM (Congrès Internationaux d'Architecture Moderne). The CIAM used contemporary architecture and town planning practices as the starting point. It was stated that architecture and town planning had to be related to the political and economic reality, to generalised industrialisation and the associated changes in social structure. The structural changes resulted in the profession being seen in a different light. More specialisation arose as a result.

Le Corbusier
Unité d'Habitation
Architect or Engineer?
A struggle of that time?
Or a struggle of each era?

Le Corbusier, born as Charles-Édouard Jeanneret-Gris, worked when he was young at, among others, Auguste Perret as an engineer and specialist in reinforced concrete. Later he worked as a draughtsman in the studio of Peter Behrens where Walter Gropius and Ludwig Mies van de Rohe were also employed. The close collaboration between architects, engineers, industrial designers and artists within large-scale industry was unique within Europe. Le Corbusier realised what man could achieve through standardisation and mechanised mass production. He was one of the founders of CIAM in 1928. The photographs show the Unité d'Habitation of 1946 in Marseille, where all the facets of integrated design come together. The base of the building, where all the piping comes together and the "bottle rack" where the skeleton of the building is the rack into which the housing units are, as it were, slid. The nursery on the roof, which is not covered by ventilation systems, etc. Every housing unit has its own boiler fed by a central boiler. Each housing unit has a view from both sides of the "flat".
People still enjoy living in this "mother" of all flats, which has 18 stories and 337 apartments www.marseille-citeradieuse.org/).



1.2 Team sport

Building has become a team sport. Together, the team finds the most optimal solution that lasts for years. This has become a challenge, because for a long time things went well for the building industry and we could go for the 'lowest' price. It was a 'demand' economy; you built and it was bought. The demand was greater than the supply.
The 'lowest' price was not the lowest price but a price that was set in advance.
Working together and integrated design offers the answer to the current challenges. Integrated design and integrated building demands trust, sharing each other's work and agreeing on a price together without raising it to pay for the in-fighting.
In recent years, the contractor was a member of the construction team, but he retained his traditional role as contractor. He still chose the subcontractors and suppliers that offered the lowest price.

In other words: innovation is needed, both social innovation and innovation within companies. However, in the current market there is much more innovation at the product level, while more innovation arises by sharing knowledge and working together to start new developments. This is also called co-creation. For this, companies have to develop something new together and not fight each other. This is where the problem lies: browse the internet and see the overwhelming amount of topics on sustainable building. Much knowledge is made available, but only a handful of companies work on it. It makes no sense to go to the umpteenth congress.
Too much explanation gets in the way of DOING. Start working, work together and get the most out of doing so!
It is normally difficult to place responsibility somewhere, because people simply do not take responsibility. Even if the placing of responsibility is accompanied by an array of arguments for why responsibility 'should be' taken.
Appealing to personal vanity 'you have to help us, otherwise sustainability is not going to work' sometimes leads to short-term results. However, it does not lead to sustainable changes.

BouwKennisBlog: 2 August 2013
The building sector should do less marketing
When you talk to (building) contractors, you increasingly hear, especially during this recession: "I should do more marketing". In the past, the clients came naturally, you only had to show your face at the local fair and people would have a job for you. You said what you thought and showed your knowledge of your profession at receptions, and potential clients flocked to your door, directly or indirectly. You did not have to act, you could just be yourself.

What has changed with 'new marketing'?
Well, eh, in reality 'new marketing' is not so new. As the introduction said, as an entrepreneur, you need to interact with people in the market in the same way as before: you show your knowledge and personality and they will find you. However, the change is in the way you do that: in this digital and flat world, you no longer do it at the local fair, but online. This is what makes 'marketing' not that different in one respect, but more so in another. Many people find it frightening to share their knowledge and personality online. Even though there are sufficient people who have been very successful doing so, also in the building sector.

1.3 Bidding is dead, long live collaboration!

"Our society will be defined not only by what we create, but by what we refuse to destroy." (Source: adapted J.C. Sawhill)
Our actions, thoughts and thinking are restricted by our self-created conditioning.
Those who can and dare shed their own conditioning and use their imagination make the difference.
Collaboration is not a new way of bidding. It demands trust and a different approach, which is not easy. The expression 'trust comes on foot, but leaves on horseback' reveals a basic truth. In 2007, Regieraad Bouw (Regulatory Council for the Construction Industry) published a booklet "Bouwen is teamwork! Praktijkgids voor succesvol samenwerken in de bouw" (Construction is teamwork! Practical guide to successful collaboration in construction). This led to 'Vernieuwing in de bouw' (Innovation in construction) www.vernieuwingbouw.nl). The booklet was published in 2007 by PSIBouw (PSI Construction) (www.psibouw.nl), a programme that has now been terminated.

It is still difficult to use this practical guide in practice. We builders are not really into the 'soft side'. However, does it still offer a step to something new? No, we really do not need to innovate, but just work together again with other local companies. Look for collaboration with people in the neighbourhood and build in the neighbourhood. If you do so, you must not and cannot damage trust! Instead of working together on one project, work has to be done across projects to reduce turnaround time, costs and the nuisance experienced in the neighbourhood.

Illustrations from 'Praktijkgids voor succesvol samenwerken in de bouw'

Tasks
Integrated design and building requires a different approach: methodological design, collaboration and LEAN. However, it mainly requires you to DO and experience it for yourself. Put together a team of people from various companies, and collaborate with the client. Adopt an open attitude and work together, crossing the internal boundaries in a project.

Pay attention to the language around you. 'Should' often suggests an attempt to place responsibility somewhere else. Without it being assumed. That is usually as effective as pushing something with a piece of string.

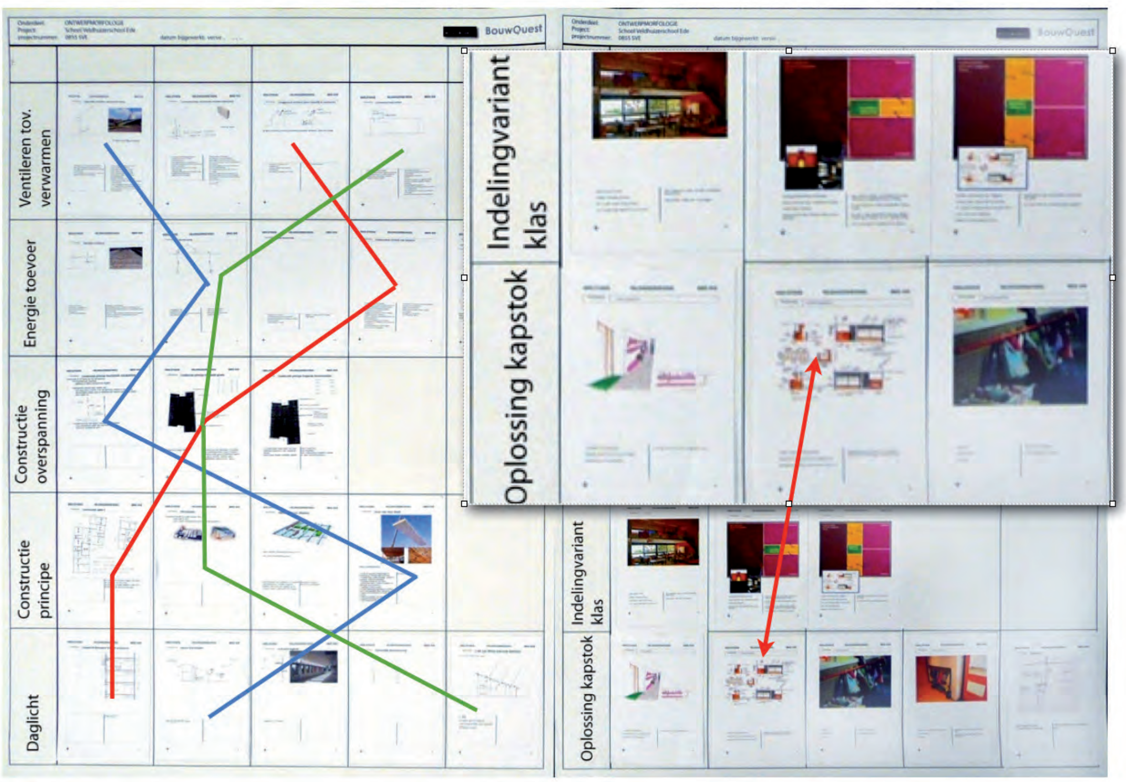
Chapter 2 Integrated design and building

Haven't we been collaborating for a long time already? We collaborate in project teams and building teams! See how we input our knowledge into the project and include the other party's knowledge in our decision-making process. Often, contracts do not allow unconditional collaboration. Goals and interests are not always project oriented. This gets in the way of taking a holistic approach.

2. Integrated design and building

2.1 Knowledge and respect

Therefore, integrated building concerns collaboration and designing together. But, how does that work? The architect starts designing and the constructor and installation consultant wait for the approval of the client before they can start. The architect's design emerges from his 'black box'. The interests of the different project partners are also wide apart. No client accepts this anymore. However, it is still everyday practice, even though teams have been formed. The reverse is also seen: the client holds a competition and the most fantastic design is picked and developed further within the design team. Is that the solution?



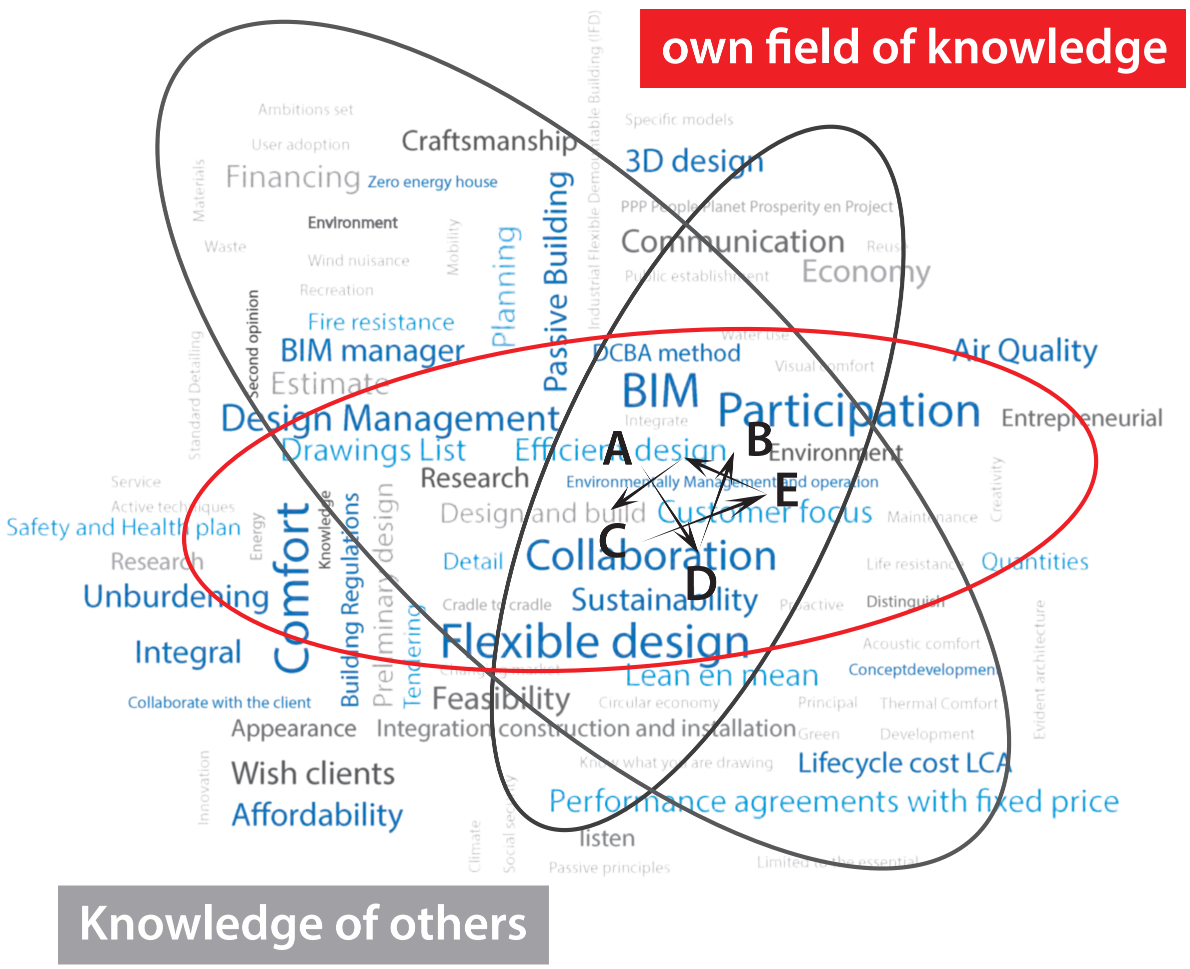
The problem is shown in the following diagram:

The diagram shows all of the knowledge that is present within the team. Team members have some overlapping knowledge domains at their disposal. It becomes apparent that only knowledge of the overlapping domains is used. Compare it to the pet subjects that are pushed solutions all the time.

The following conversation is therefore very familiar:

(Installation consultant) Dear architect, could you change the roof so that we can use adiabatic cooling? (Architect) I would not know how to do that! Can't we just use a heat pump, we can surely use that for cooling? (He thinks to himself: I don't know what adiabatic cooling is, so there's no way I'm going to change the roof!)

The proposal is shot down in advance instead of leading to a discussion about the how and why. Even though the entire Alhambra complex in Granada is being cooled adiabatically!



Only the common knowledge is used.

Source: Perica Savanović Integral design method in the context of sustainable building design

Veldhuizerschool

Fresh and passive house school

No musty classrooms. A school that is heated by the children themselves. A school without a gas supply that uses 80% less energy. You can just open a window, but it is not necessary. Wouldn't it be great to be taught there?

The Veldhuizerschool was proclaimed the freshest school in The Netherlands by AgentschapNL in November 2012.

Fresh work and study climate

The school board sees the advantage of a well-ventilated study environment. Therefore, this was one of the wishes. It has been scientifically proven that fresh classrooms achieve better work and study results than the current rooms. In the new building, the amount of fresh air that enters a classroom is 1.5 times greater than the requirement in the Building Regulations.

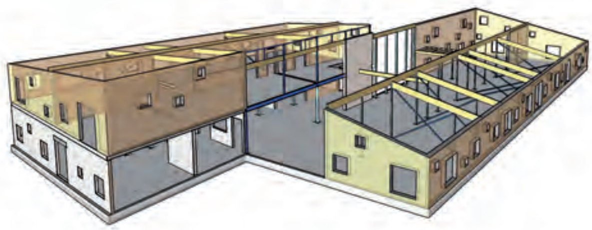
Building passively: the children keep the school warm in the middle of the winter

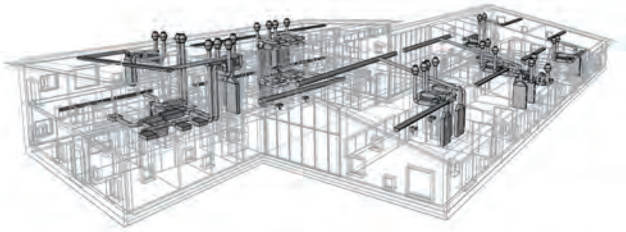
The school has no underfloor heating and no radiators. It does not even have a gas supply! Geothermal energy heats the school to the correct temperature early in the morning. Then the children in the classrooms produce sufficient heat to keep the temperature comfortable. In the summer, the system can provide cooling. Passive building ensures a stable indoor climate.

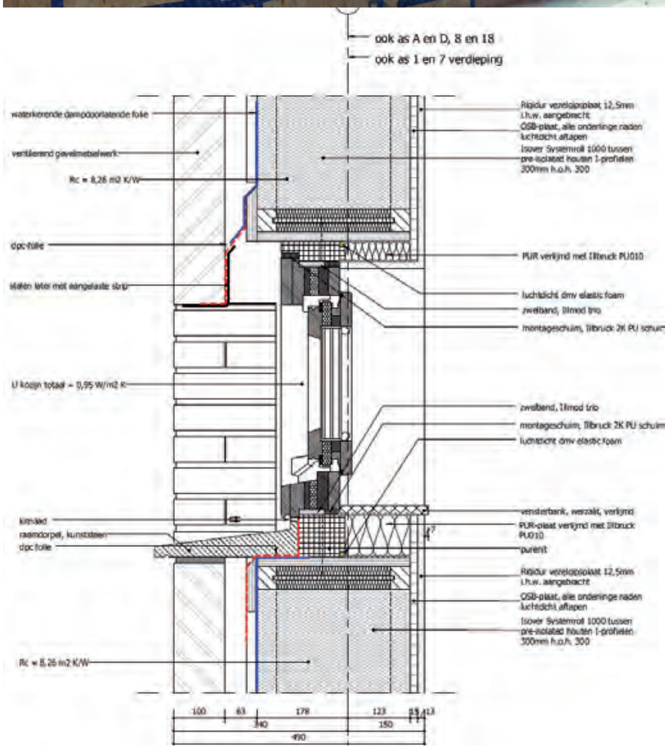
When compared to a new building that only satisfies the requirements of the Building Regulations, this school saves 80% on primary energy. The air that is exhausted transfers 90% of its heat to the air that is drawn in. These values are only reached because the building is built to be airtight.

3D Collaboration in a flat organisation

The new method of working is: first build the project digitally and then construct it for real. All of the data are in a single virtual 3D model. This model is called a BIM (Building Information Model). BIM is not a software package, but part of a way of collaborating: design management. When working with the BIM method, it is important to divide the assignment, in this case building a school, into smaller sub-assignments. For each of these sub-assignments, solutions are sought that can be combined with other solutions. Only the manageable solutions are proposed to the client.

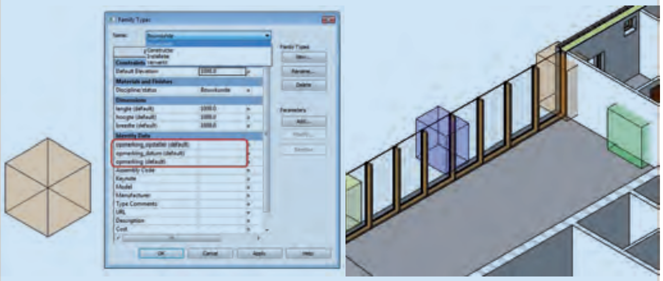






Diverge and converge.
BIM results in a faster turnaround time with more combinations and input from all disciplines and is therefore a fine tool.

Veldhuizerschool
The new building of the Veldhuizerschool in Ede provides space for eleven classes and a playroom. For this project, the disciplines civil engineering, installation technology, construction and furniture were integrated in a single 3D model. Using Revit from Autodesk, all of the different aspects could be aligned. The different disciplines were represented by three different companies at three different locations. Working together in an external project archive (Chapoo) allows files to be easily shared. Everyone had the opportunity to provide input: when, for instance, the civil engineers found that part of an installation was too low, a transparent message box (see picture) was added. This was then addressed by the installation consultant. Therefore, every party remains responsible for his own part, while coordination is guaranteed. This working method is achievable in practice. "BIM with both feet on the ground!"


Transparent message box to exchange information

Design management
HartmanBouwVisie and BouwQuest are located in the same office building and have developed a joint working method called 'design management', that does justice to this innovative working method. This school is a clear example of integrated teamwork, where all disciplines were involved from the beginning of the design process. Therefore the design was not made in advance with the installations having 'to be shoe-horned in' later. No, each discipline made a contribution based on the programme of requirements. Design management ensures that the different parts are correctly aligned. Something that seems obvious, but is often not the case in practice.

Within design management, the different consultants are on an equal footing. A flat organisation of the design team is required to ensure that the input from all consultants is valued equally.
In this process, collaboration with different architects is possible. Jorissen Simonetti Architects is involved in this project. Within the BIM, HartmanBouwVisie, Intechno Ingenieursburo and Bartels Ingenieurs have collaborated closely.

Estimated realisation costs: € 2,947,000
(Crisis: -7.5% market forces)
Actual realisation costs: € 2,765,000.
(€ 1,200.00/m2 GFA, excl. VAT)

The freshest School 2012

It is only an example of how we deal with each other's knowledge. In practice, it is sometimes difficult to find parties listening to and respecting each other's work. It is also difficult to have to collaborate as a client, designer, consultant, builder and installer while there are also other projects where this is completely impossible. In the traditional approach, each party has its own contract specification and responsibility. This often leads to sub-optimisation and loss of coordination (also known as 'failure costs', but we do not want to mention that term too much here). Even though it is indisputably established that improved collaboration results in higher profits for all parties. An optimised project runs smoothly, generates benefits in both time and money and offers more job satisfaction with less stress. The intentions are there, but daily practice is intractable.

Nobody is perfect, but a team can be

2.2 Collaboration

To ensure collaboration, different methods are used. The technician prefers to use a technical method and appreciates it when software can do the job. However, collaboration must be organised, where you first you want to have commitment on different levels.

Structure	Human	Collaboration
Phasing	Goals	Communications
Quality	Incentives	Expectations
Planning	interests	Team building
Information	Competencies	Work agreements
Organisation	Preferred role	Decision making
Finances	Commitment	
Risks		

Goals and interests are not always project oriented. Companies often have a different goal. There is nothing wrong with that, but expressing a common goal, such as the continuity of the companies, is a good motive. Especially at this time, it is good to be open. By respecting each other's interests, the common goal can be met.

Collaboration Veldhuizerschool team

2.3 Complexity

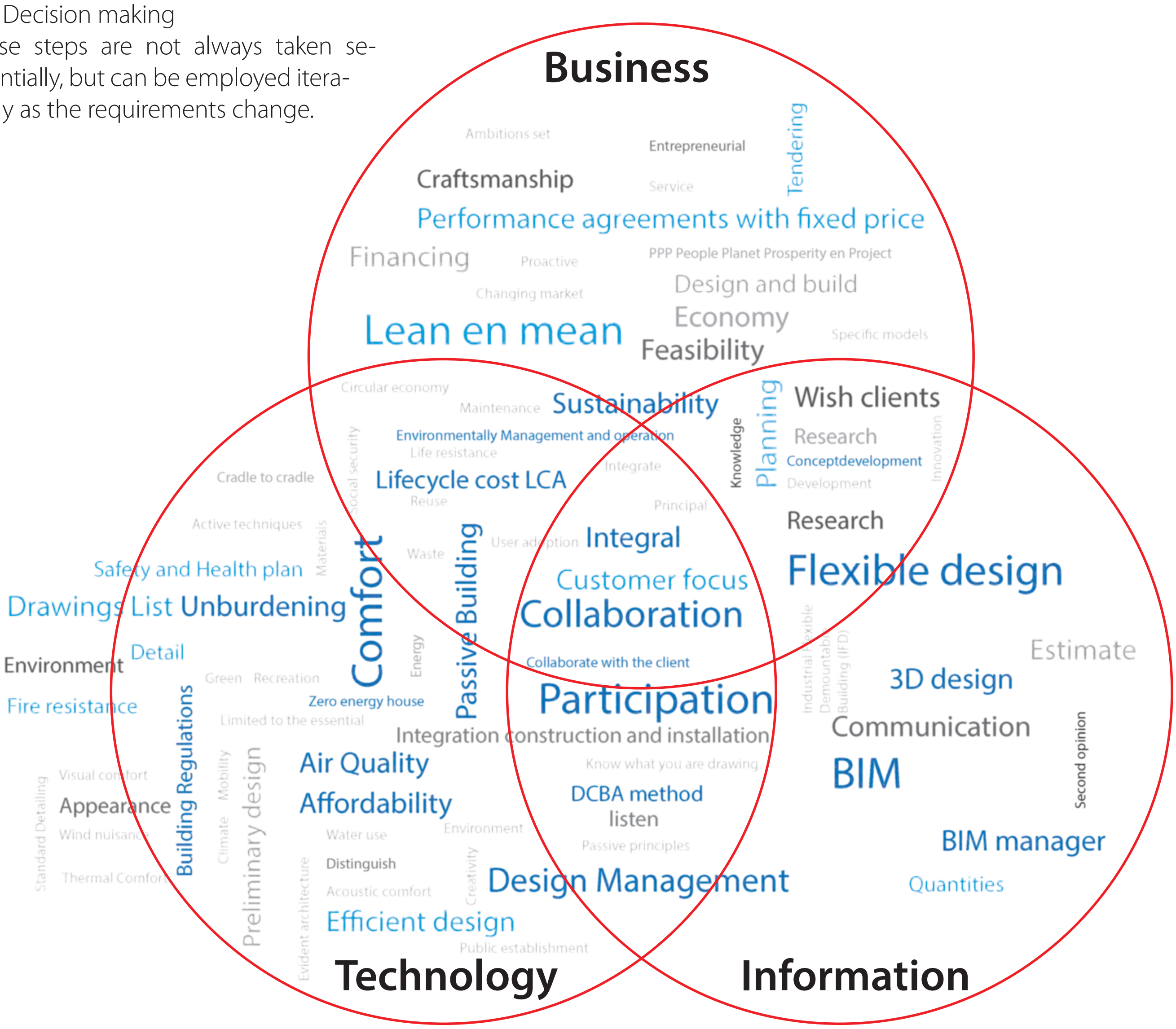
Building has become complex. Integrated designing and building means looking from different viewpoints. A sustainable project demands a holistic approach. Good collaboration is necessary between the client, the design team and the contractors who all have their own knowledge and goals (interests). There are different approaches to arrive at a good design/project: a team or creative approach, a pragmatic approach or methodical designing. Always examine the entire problem, therefore, take a holistic approach.

Three steps can be distinguished in every approach, these are:

- Conceptualization
- Opinion forming
- Decision making

These steps are not always taken sequentially, but can be employed iteratively as the requirements change.

In the diagram, the holistic approach is divided into the multidisciplinary technology-oriented, information-oriented and business-oriented approach. Currently, the holistic approach is almost exclusively driven by energy savings. This is because energy saving influences all aspects of the realisation, the exploitation and the environment. Integrated solutions, where the variants are analysed at the early stages are now required.



Scheme from three competence dimensions: Multidisciplinary technology-oriented, information-oriented and business-oriented approach.

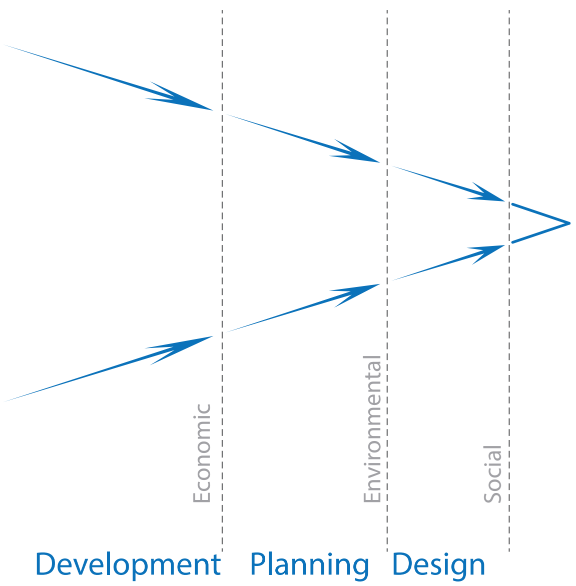
Not every solution for a sub-assignment can directly be set-off against a solution for a different sub-assignment. Within the variants, solutions can contradict each other, while they enhance each other in another variant. Considerations are not quantifiable. Usually the sub-solutions are recalculated into monetary terms to make them quantifiable relative to each other. The cheapest sub-solutions are then chosen.

This is why a phased approach from large to small is often chosen.
This approach is common, especially in traditional construction. However, is this sustainable? No, not enough attention is given to the entire picture, let alone the lifecycle of the project. Often the problem is left on hold, 'it will be solved by the next partner in the project'.
It is better to start "re-thinking" from the viewpoint of the design and the party who wants to build. Only then will the development start where the economic, political, environmental and social factors are investigated integrally for all facets of the process. Instead of the developer being involved at the start of the process, he becomes involved in investigating the combinations with financial possibilities at the end of the process. At the start of the process, we now find the user with his ideas. This is an important turn around, especially in renovation projects.

Frank Lloyd Wright:
"Form follows function - that has been misunderstood.
Form and function should be one, joined in a spiritual union"

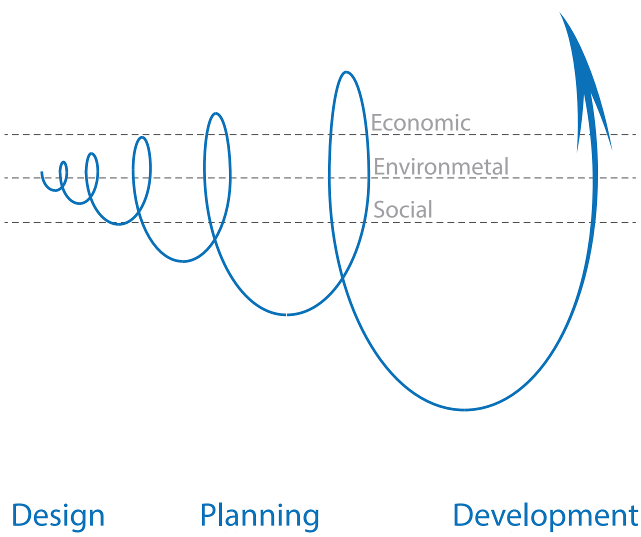
Tasks
Listen and respect other people's knowledge. Draw up a joint contract. It seems strange in today's world to make an inventory of the goals of all of the parties and to help each other to achieve these goals, but it is a human approach. This requires people to be open with each other. It will benefit all, in terms of money but also in terms of the relationships, allowing you to tackle more projects together.

Current Paradigm



Choices are often made from large to small

Integrated Design Process



Chapter 3 Methods

This chapter summaries the various ways to arrive at an integrated approach. Collaborating via BIM and LEAN is insufficient. Not all parts of the building and the functions within the building can be weighed up against each other. Choices are not quantifiable. But how do you make the correct choice? By expressing it in terms of money? No, you take a methodological approach that properly assesses all facets of building.

3. Methods

Many methods can be used to achieve an integrated design. Currently, new methods are being developed that are based on energy saving variants. Here the emphasis is placed on situation, climate, thermal comfort, acoustics, ventilation, materials, energy systems, construction and usability. This comes close to the holistic approach, however leaving out the schedule of requirements, function, visual comfort and environment, as well as the business side and information side of the holistic approach. Therefore, in The Netherlands integrated designing and building is mentioned in the same breath as Lean and BIM.
Methods are:

- Systems engineering
- Workflow maps Level of detail LOD
- Morphological design

The industrial designer **Luigi Colani** created various aircraft and trains in the sixties. A designer with his own design style, you know what his designs will look like. Within **systems engineering** this method of designing is almost impossible. Even so, there are some advantages. Had this designer developed the Fyra train, public opinion about its failures would have been milder than it is now.

OMA:
architecture is monstrous in the way each choice leads to the reduction of possibility. It implies a regime of either/or decisions often claustrophobic, even for the architect

3.1 Systems engineering

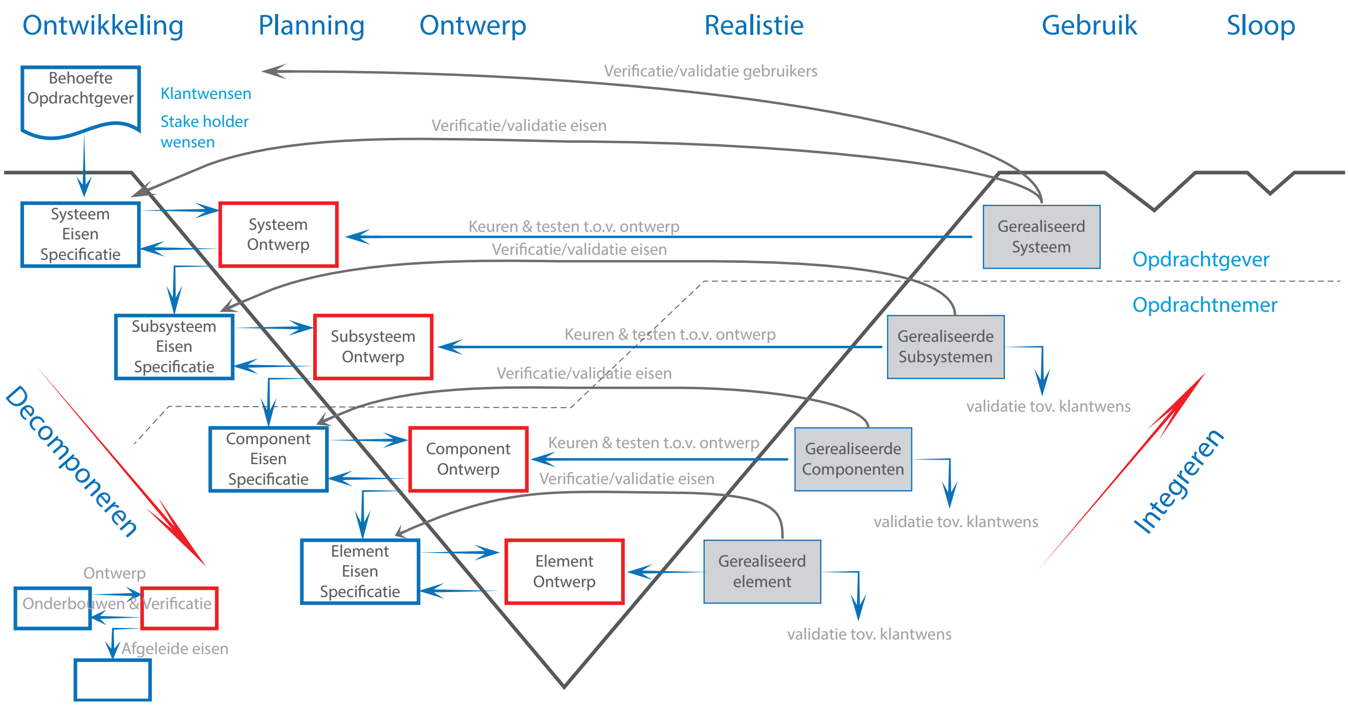
Systems engineering is a structured design method where everything is continuously inspected from the perspective of the entire system. The requirements of the client for building a project are taken into account and adapted throughout the process. Systems engineering is in principle a methodical approach. This iterative process continually demands the interaction of the different disciplines. Where the 'why' is repeatedly asked and the answer recorded. This results in top-down development and bottom-up realisation, the so-called V Model, where in the development stage everything is integrated in the total system. All decisions and approvals are recorded in the Relatics program, which relates the requirements to the function of the building elements using a function tree.

The systems can be the different disciplines that must collaborate, but they can also be different parts of the building.

There are eight steps in systems engineering:

1. Requirements analysis
2. Requirements validation
3. Functional analysis
4. Functional verification
5. Synthesis
6. Design verification
7. System analysis
8. Checks

Guiding principles within systems engineering are: focusing on what the client wants, system thinking, transparency, efficiency, best price/ quality ratio, balance between design freedom and contractual agreements, checks & approvals, project management alignment and especially openness.



V-Model: Top-down ontwikkeling en een bottom-up realisatie

The booklet "First read this" systems engineering in practice published by '010 uitgeverij', explains the possibilities and impossibilities. Two examples:
1. Creative solutions (design freedom) are judged too quickly on their price/ quality ratio (the costs), because there is a lack of knowledge to correctly validate the considerations of the other person.
2. Think in terms of risk, where every risk has to be averted to be able to tick every requirement. Here, certain risks can be missed and other risks can be over compensated in advance, causing safety thinking to threaten to spiral out of control.

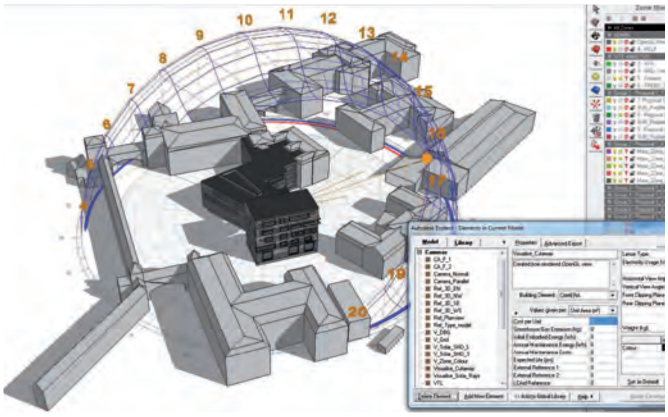
Pick and place unit
At Viber Metaal (incidentally, this company has just gone bankrupt) a fully automated machine for putting down and collecting traffic cones was developed using systems engineering in 2008. This machine is also capable of picking up cones that have fallen over. A fine piece of work. Even so, not many of these machines are seen on the roads. Would it not have been easier to amend the traffic cones?

Ensure explicit information transfer. An iterative process does not work if the parties in the chain operate as separate entities. Open communication between all parties during the entire lifecycle of a system is a prerequisite for working successfully with systems engineering. BIM and Lean can be used for this.
For large infrastructure projects and very large utility constructions, systems engineering is the solution for collaboration among parties. A good example of this is the National Military Museum in Soesterberg, which was built in a Public Private Collaboration and is managed by Heijmans. The booklet 'Leidraad SE' (Guiding principles of SE) from ProRail and Rijkswaterstaat shows how systems engineering can be implemented.

3.3 Workflow maps

A method that is currently embraced by Autodesk is Workflow maps. This method was developed by, amongst others, Asbjørn Levring, Strategy and BIM specialist – Danish Technological Institute in collaboration with Santec. The AIA (American Institute of Architects) also uses a similar method, where a project is divided into phases, which is based on a work strategy defined in advance. This uses new types of analysis software that can do numerous simulations on the 3D model within a BIM model. The simulation is used to amend the design.

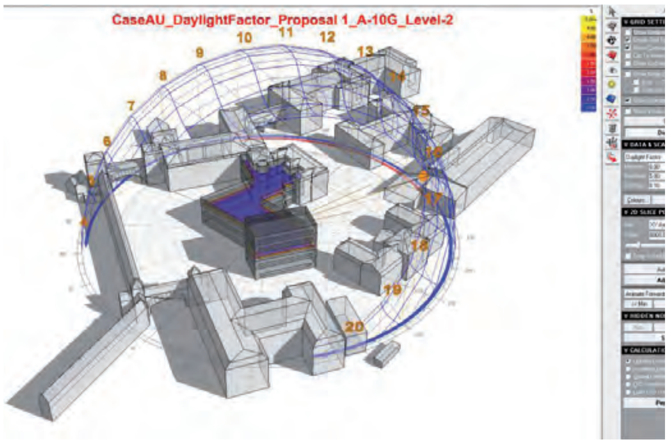
A method that is fully driven by energy saving. This is not for nothing: if a design is correctly oriented it could easily use 30% less energy because of its shape, than if these aspects and hardly taken into account. For example, the overhang of the eaves can be crucial to prevent or encourage overheating. The method or, more correctly, methods, can be used as a roadmap in the optimisation process to strive to use the least energy and achieve a good balance between technology and construction methods in the design.

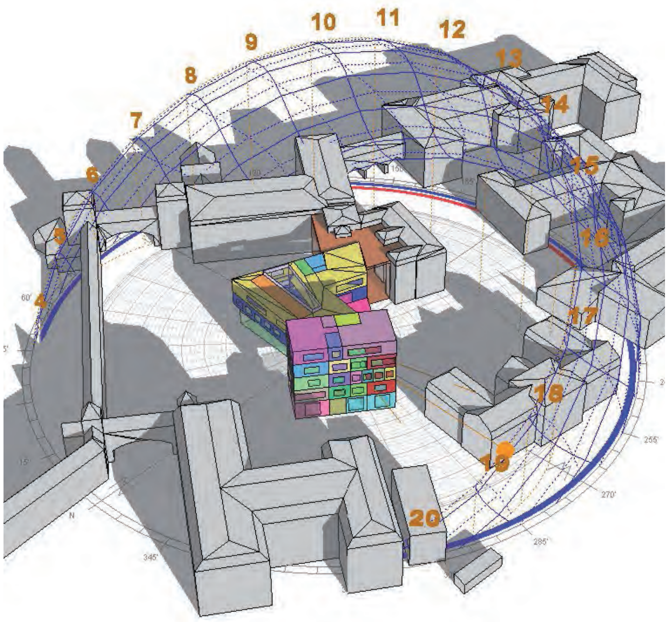


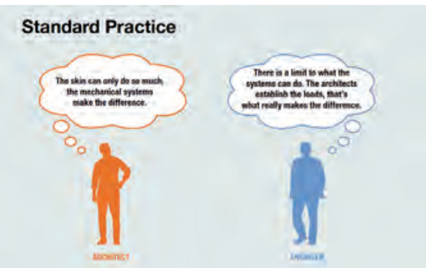
3D analysis of daylight and shadow

Here the 3D model is central, with the different aspect models and the simulation being aligned. The Integrated Project Delivery protocol, which was written previously by the author, helps to map out the agreements to use each other's work.

In fact, the information required to create a good design should be available earlier in the design process.



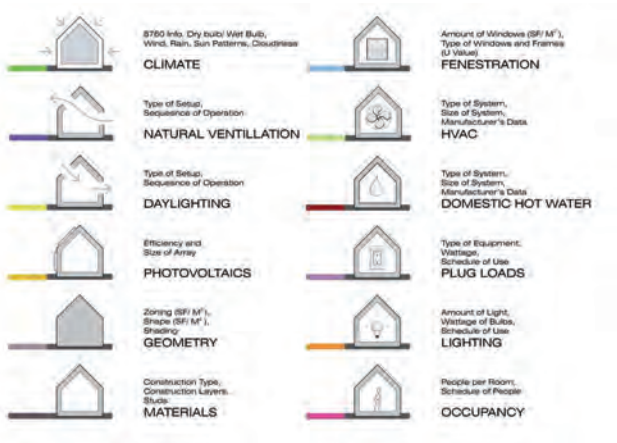




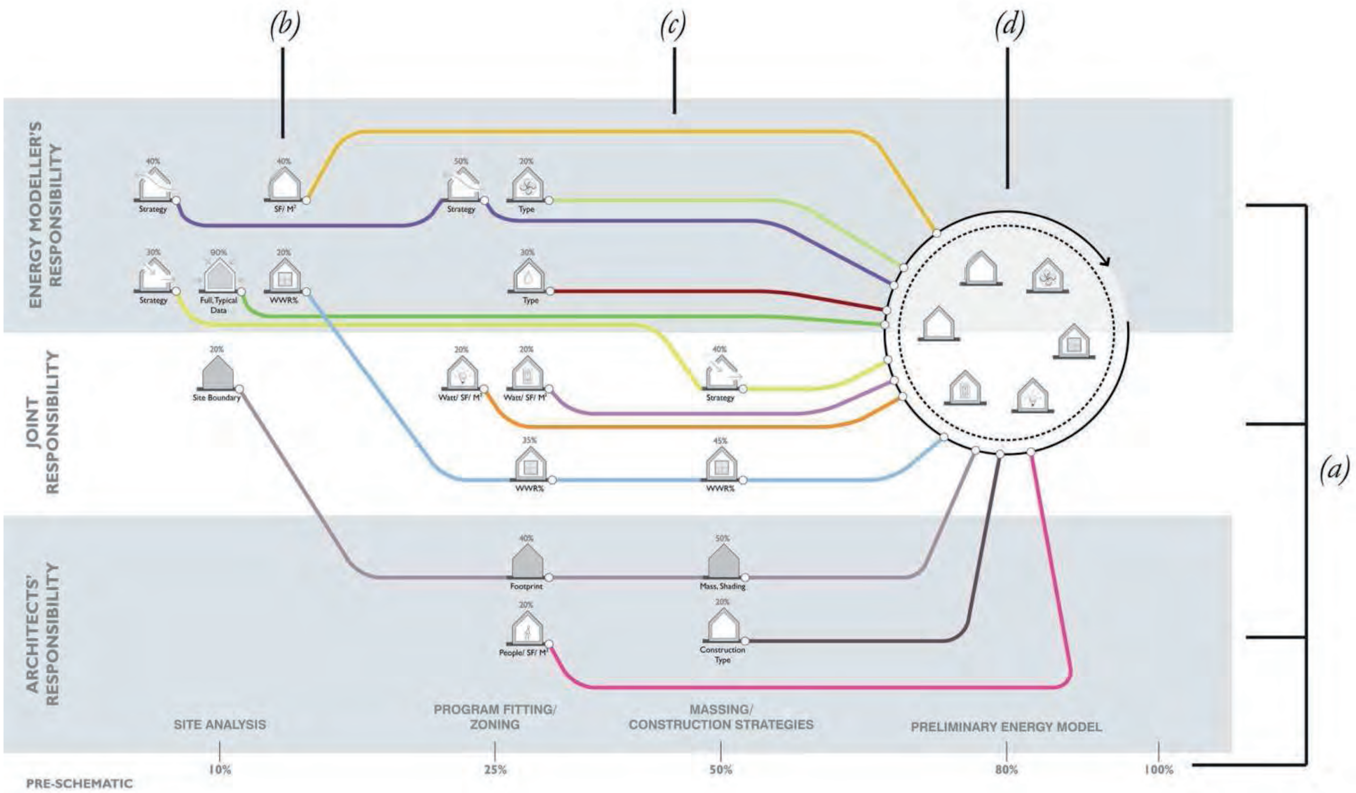
The modeller becomes an intermediary between the architect and the engineer.

The different simulations are then compared and placed within a workflow. The workflow shows which models need to have reached a specific level of development (LOD) to be able to make the right design choices.

The companies that make AEC (Architecture Engineering and Construction) software are working in all areas to find new directions within the Building Information Model (BIM) model. It is already possible to make simulations in the area of climate, ventilation positions of windows, daylight calculations, ventilation systems, hot tap water, PV cells, electricity use, geometry, light, materials and occupancy.
By incorporating the simulations into a 3D model, each change can result in the immediate visualisation of the energy consumption of the project. Therefore, it is an integrated approach.



The workflow map shows different LODs (a) different disciplines (b) information exchange (c) information flow and (d) energy model



3.4 Morphological design

To master a complex design process you can divide up the problem. Unravelling it makes it manageable. Little sub-solutions can give rise to large solutions. This process is profound and costs more time than traditional processes. However, the subsequent project phases can be completed faster.
With this design method, the client is involved in a neat and clear decision-making process. In the traditional approach, the client rarely has the choice of more than one or two options. These options are usually the architect's preference and the option that is likely to be turned down. This gives an unsatisfied feeling. See (Un)satisfactory decision-making.

A morphological overview is a methodical design method. The method was developed by Fritz Zwicky (1966). The objective of the morphological overview is to identify and compare all solution directions, which are normally unquantifiable.

A complex problem has multiple characteristics:

- Multidimensional: it can be approached from many points of view. For example, the problem could concern financial, political and social aspects. These different aspects are treated as a single entity in the solution.
- Vague: The different aspects of the problem are unquantifiable. Moreover, they are continually subject to change. The vagueness of the different aspects makes the use of the usual 'cause-effect' methods unsuitable.
- Subjective: There is not one good solution to the problem. There are only better or worse solutions.

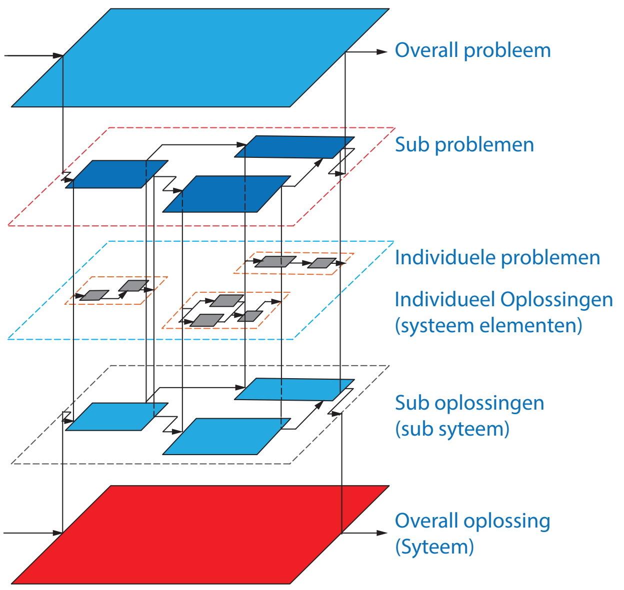
(Un)satisfactory decision-making
Research carried out by the Vanderbilt University showed that a choice is made when the available information has reached a certain critical level. If the level has not yet been reached, the decision is not yet satisfactory. When there is too much input, it no longer influences decision making. One of the researches gave a married couple three minutes to choose the best house from all of those available from an estate agent.
The research showed that the couple chooses the same house if they were given half an hour and a spreadsheet to investigate everything on offer.
A choice is made as soon as the visual information is clear enough.

A couple knows which house suits them best within three minutes

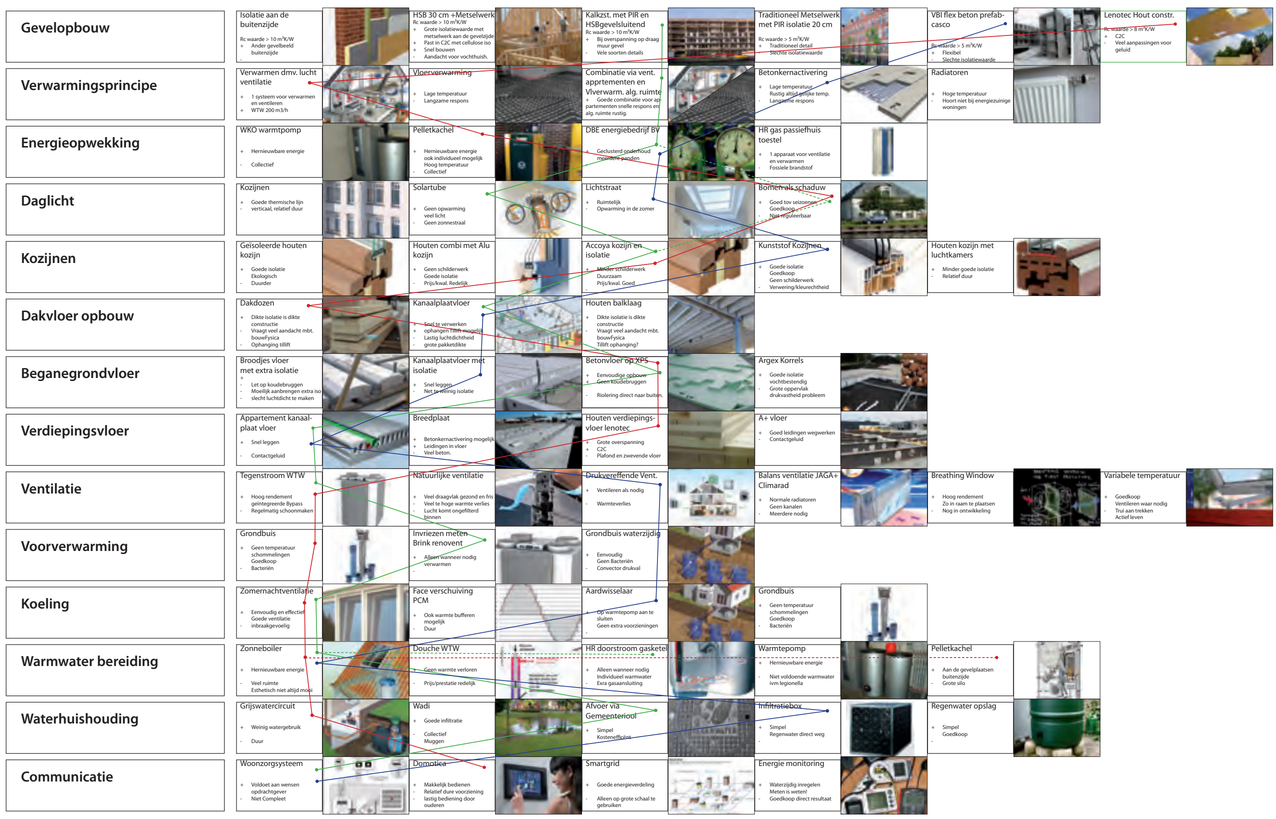
As in every other process, the quality of the input also determines the quality of the output. If the basic information (input) is qualitatively better, there is a greater probability that the result (output) will also be of higher quality. It is also desirable for the project team to include at least one person with experience in making morphological overviews.

The following process steps are required to make a morphological overview:

1. Problem description (conceptualization): a description of what the problem is, what it is not and what it could be.
2. Analyse the solution parameters: the problem is divided into viewpoints and/or characteristics (dimensions).
3. Build a morphologic overview: the overview helps to order thoughts and visualise them in a matrix. All possible conditions are summed up for each dimension.
4. Evaluation (opinion forming): evaluating a possible solution by judging it for consistency. If a possible solution is inconsistent, then an (x) is placed in the appropriate field. The last step of the process is shown by connecting the desired solution with a line.
5. Implement the solution (decision making): implement the desired solution as depicted in the morphological overview.



By diverging from and converging towards the formulated problem, the best solutions emerge.



Completed morphological map of assisted living complex in Vroomshoop.

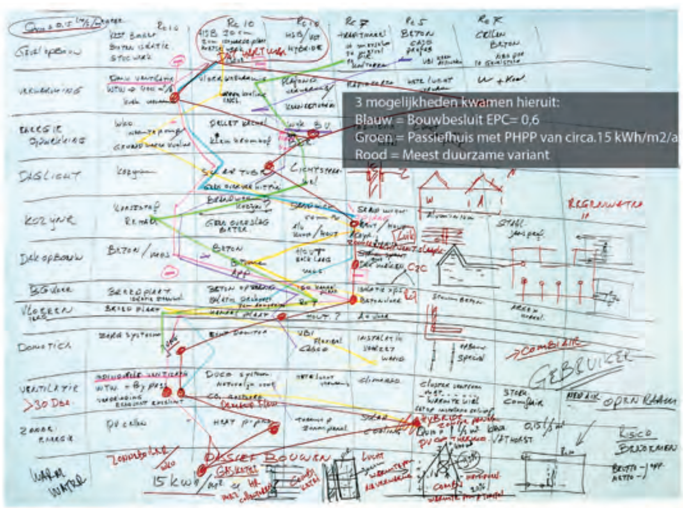
Assisted living complex Stationslaan, Vroomshoop
A small assisted living complex is being built at Stationslaan 10-12, Vroomshoop, The Netherlands. The sustainable passive house building is destined for clients of the Baalderborg Group who have a mental and/or physical disability.

Design
Peters and Lammerink Architects (Hengelo) are the designers. They have designed an attractive building that is in harmony with the surroundings. The design was submitted in 2010, it has been delayed because of the changes in the zoning plan.

Selection
'Mijande Wonen' chose to issue a contract for a design that met the Environmental Permitting (General Provisions) Act. Requests for tenders were issued to five contractors in the region for this design and a programme of requirements. The budget was set at € 2,325,000 excl. VAT. A party was sought that could build the highest quality and most sustainable building based on the budget and design. Karsten Construction Company, Alferink Installation Company and BouwQuest were selected because of the integrated solution they could offer.

Layout of the building
Twenty-one apartments and one ' 'parent-child apartment' will be created. Every occupant will have his or her own apartment in this new type of housing. In addition, there are communal facilities, including common living rooms, kitchen and office space.

Passive/ massive building
Sustainable construction has become an unstoppable trend. Energy saving construction is gaining ground out of respect for man and nature.
The building on the Stationslaan is one of the first assisted living facilities in The Netherlands that is being built passive/ massive (brick /concrete building). This maximises the use of the integrated design methodology, BIM and project delivery. Passive construction aims to achieve minimal energy use with maximum comfort. 'Passive' solar energy is used to the fullest, so that the use of energy for heating (and cooling) can be kept to a minimum. The result is a comfortable, healthy and extremely energy-efficient building.



Sketched morphological map of the 22 assisted-living apartments.

Integrated designing

The building process involved the entire BouwNext team. To be able to respond to the wishes of the client as optimally and sustainably as possible, a morphological map was used. The choices were recorded in a Building Information Model (BIM). This model contains all of the information about the project, viewed from all disciplines. It is shared by all of the collaborating parties and becomes richer in information throughout the project. The use of a Project Information Management system (PIM) supports this working method. It provides a clear base for the construction of the innovative project.

The housing units have been developed according to the passive house concept. The construction was made of lime-sandstone blocks and concrete floors. The door and window frames, for example, are made from insulated wooden profile with triple glass. All gaps have been doubly sealed. The living complex as a whole is built airtight to retain as much energy as possible.
Because the building is very energy efficient, the housing units can primarily be heated with air. This makes radiators superfluous, results in a pleasant climate in the apartment and has the following characteristics:

Soundproof and therefore quiet in the house

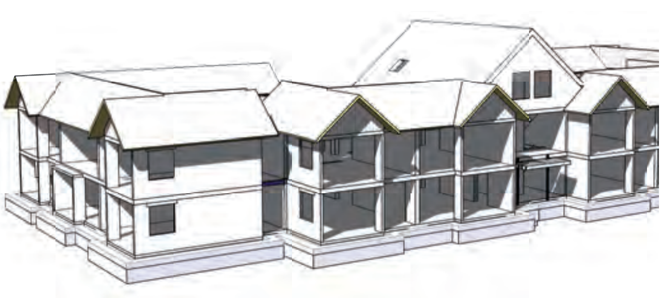
Less draughts due to internal heat differences

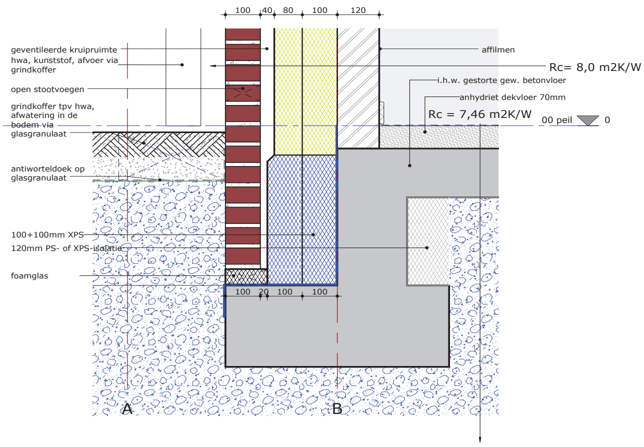
Ventilation with exclusively (clean) outside air. This air is heated in advance to the right temperature by the outgoing air. This is done by a heat recovery system. In the winter, the air is preheated and in warm weather, the air is precooled.

An extensive night ventilation system in the building ensures that the temperature is cooler at the start of warm days.

In summer, the blinds are automatically activated to repel as much heat as possible. In winter, the heat from the sun is allowed to enter the building.

The foundations are made from glass foam granulate.



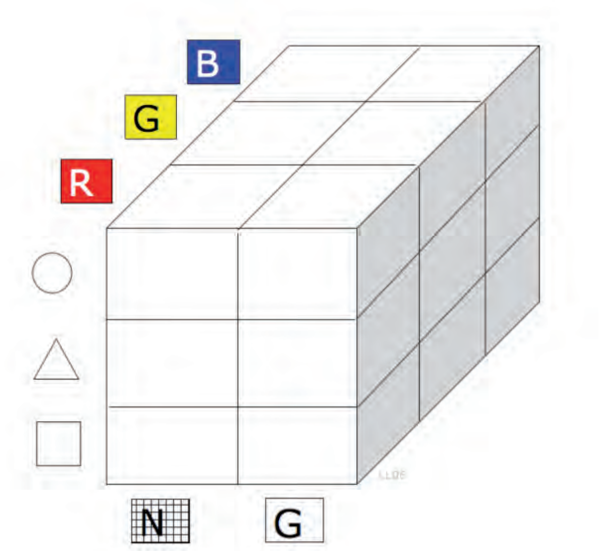


Detail of the glass foam granulate foundation
Airtight installation of door and window frames

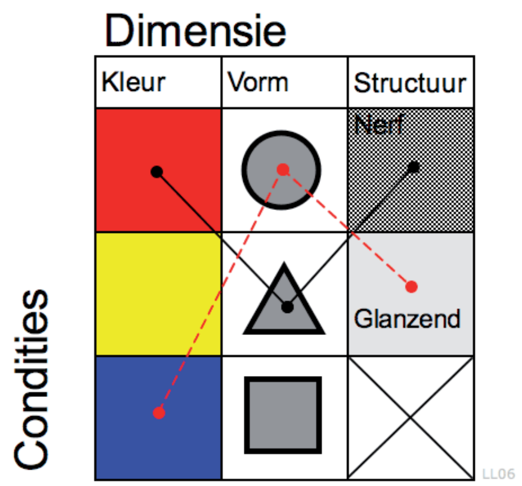
A morphological overview can be made with n-dimensions, where each dimension has its own viewpoint or characteristic. For instance, a Zwicky box can be used.
It is easy to represent the structure in a matrix that can also include the following topics.

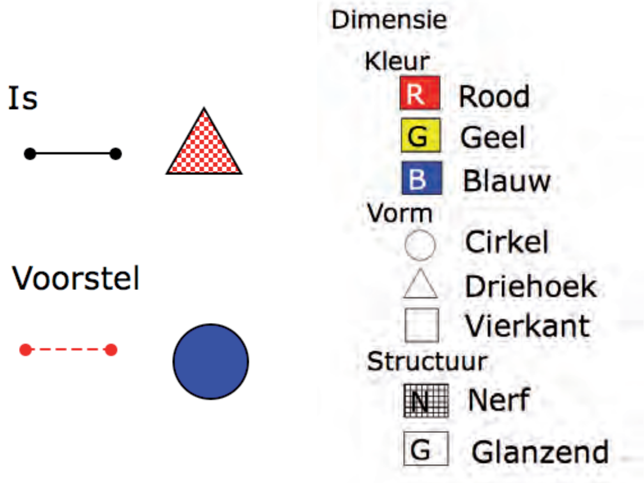
- Situation,
- Climate,
- Programme,
- Function,
- Thermal comfort,
- Visual comfort,
- Acoustics,
- Ventilation,
- Materials,
- Energy systems,
- Construction,
- Usability and safety
- The environment

All sub-problems associated with the project are mapped out in this way. ALL parties help to provide sub-solutions. As a result, the map includes input from all disciplines, from the client, the architect, the consultants as well as the builders and the installers. Each discipline provides its own input and will include its best solution in the map (conceptualization).
When all the information has been entered and classified with respect to its pros and cons (opinion forming), multiple solution directions arise and are compared. A clear picture eventually emerges that, although not being quantifiable, will provide enough input for good decision making.



Tasks
The contribution of all parties (the client, the design team and the builders) has value. Because everyone can contribute to the morphological map, a well-considered decision can be taken. By taking a methodological approach, the conceptualization, assessment and the decisions are well founded. Optimisation leads to a sustainable result.





Chapter 4 That was the theory. Now the DOING!

Technology is not the aim, but it helps to achieve the right result. Sufficient daylight, safety, thermal comfort, air quality and acoustic comfort must be aligned to achieve a pleasant living environment.

You no longer need to bid against each other, but to trust each other to work decisively together. It is important to act flexibly and not be restricted by only considering short-term profit. The morphological approach to working requires the support of an efficient information flow. BIM and LEAN can help you to act simply and flexibly. And to keep the focus on the client.

4. That was the theory. Now the DOING!

The doing happens in three areas: technology, process change within the company and information.

SME (small and medium-sized enterprises) and suppliers still focus on project-related fragmentation, where they address innovation in a fragmented way for each project. This gets in the way of integrated innovation.
Technical innovation is adopted by early adopters, but there is a large gap to close between the early adopter and the early majority. The early majority only wants to use an innovative product when it has proved itself. However, the construction process is so fragmented that many innovative products become left by the wayside before they can prove themselves. For innovative products to be successful, they must, together with other products, result in a comfortable solution. The project (and not a particular product or device) is judged in its entirety. Implementation almost always revolves around creating the right circumstances. Usually, the innovator already has something new for the early adopter, who will make it his own. This in contrast to the majority within the construction industry who continue to build traditionally.

Process innovation is required to break through this impasse. The lines must be short between SME, suppliers and clients where energy efficient accommodation and renovation are concerned.
We distinguish three hurdles: lack of motivation, lack of knowledge and lack of skills. There is only one thing to do: DO.
Propelled by the economic crisis, the lack of motivation is slowly dissolving. Most companies are doing their best to stay afloat. The willingness to grasp at every straw because of the personal involvement of a company's owner gives hope. A lack of knowledge can be compensated by sharing knowledge within networks. A lack of skills can be compensated by just doing. By companies that create a permanent team that serially develops individual projects.
The transition (from a fragmented to an integrated approach) must be started, especially within the renovation sector. The assignment is always technically different, but the approach can be the same.

4.1 Technology

Technology is the easiest area to address. There is a lot written about it. A good example is the book "Architectuur als klimaatmachine" Handboek voor duurzaam comfort zonder stekker (Architecture as a climate machine, A guide to sustainable comfort without using electricity), by Vera Yanovshtchinsky, Kitty Huijbers and Andy van den Dobbelsteen. Here integrated technology is used to achieve a high level of comfort.

The idea of comfort depends on a person's perception and is very subjective. What one person finds pleasant may be unpleasant for someone else. Comfort depends on the climate. A person living in a warm climate wants to cool down and vice versa. It is also influenced by culture and the way of life. In The Netherlands, we build spaces that are comfortable for the "average" person and that can be adapted for the individual. The inability to open windows is immediately felt as being uncomfortable, even though it is part of a solution that satisfies all of the requirements.

The technology used to create a comfortable house or building can be divided into different subjects, in addition to urban comfort and climate:

- Visual comfort, daylight
- Safety, fire compartmentalisation in the functional design
- Thermal comfort, insulation
- Air quality, ventilation
- Acoustic comfort
- User adaptation

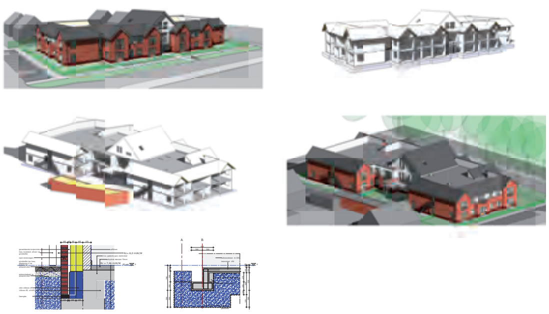
And all as optimised as possible, even if some subjects can conflict with others at sub-levels. It is important to find a balance.

Optimisation is often equated to "as little energy as possible". This is derived from the Trias Energetica, a strategy developed in 1979 under the leadership of Kees Duijvestein.

The three steps of the Trias Energetica provide basic rules for the sustainable design of buildings. These three steps are:

1. Limit the energy consumption by avoiding waste; therefore make use of insulation, triple glass and air tightness
2. Make maximum use of energy from sustainable sources, such as wind, water and solar energy;
3. Make the most efficient use of fossil fuels to meet the residual energy demand.

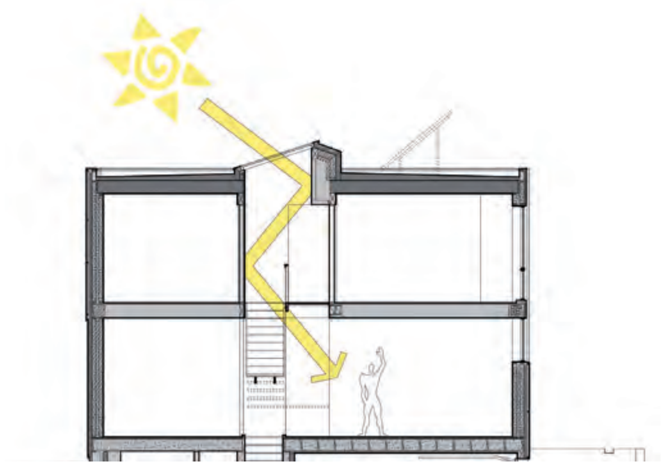
As already said, you cannot get your head around this complex subject without using integrated thinking and designing. Collaboration is important from day 1. Not only the architectural staff/contractors and installers, but also the client, the user and if required the financier must participate as much as possible in the project.
Integrated DOING with a morphological map is the best solution for housing, utility construction, up to a value of 10 million euros (90% of buildings, above this value the projects become too complex), and renovation.
The morphological map addresses the subjects required to achieve the highest possible level of comfort. After all, a pleasant building that features high user adaptability is also a sustainable building.



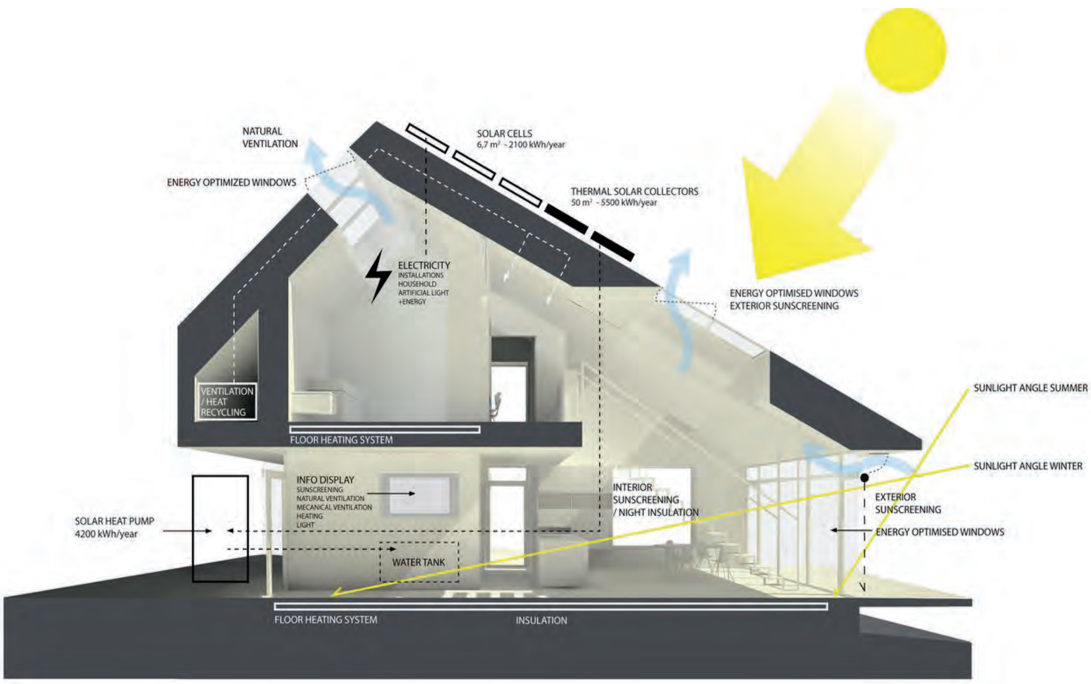
A study resulted in the following comparison of the average number of aspects and sub-solutions that were generated by the design teams in design Session 1 (without morphological tools) and design Session 4 (with morphological tools).

Visual comfort

A lot of daylight is good for our daily biorhythm. The blue daylight in the morning activates us and the red daylight at dusk makes us sleepy. Moreover, we want to use as much passive light as possible. You can use artificial light where necessary, but try to avoid it as much as possible throughout the day. However, unlimited amounts of daylight also have a downside because of the large contrast it creates between light and shadow.
In addition, it is also important to take the view into account. Being able to look outside is a must for people who have to work for eight hours a day in a room.



We want to use as much passive light as possible. A lot of daylight is good for our daily biorhythm.



Safety

It is important to cluster the different functions with respect to thermal comfort: for example, an office is separated from a gym. However, separated functions within the organisation must be accommodated in their own fire compartment. Consider the office and the workshop. By carefully addressing fire compartmentalisation, functional separation and climate zones at an early stage, clustered thermal comfort is easier to realise in the later stages. Trying to use installations to do this at a later stage for a low-energy building is nearly impossible.

Thermal comfort

This is defined as "a state that expresses satisfaction with the thermal environment". Thermal comfort is determined by seven parameters:

Individual:

1. Metabolism
2. Clothing
3. Body temperature

Surroundings:

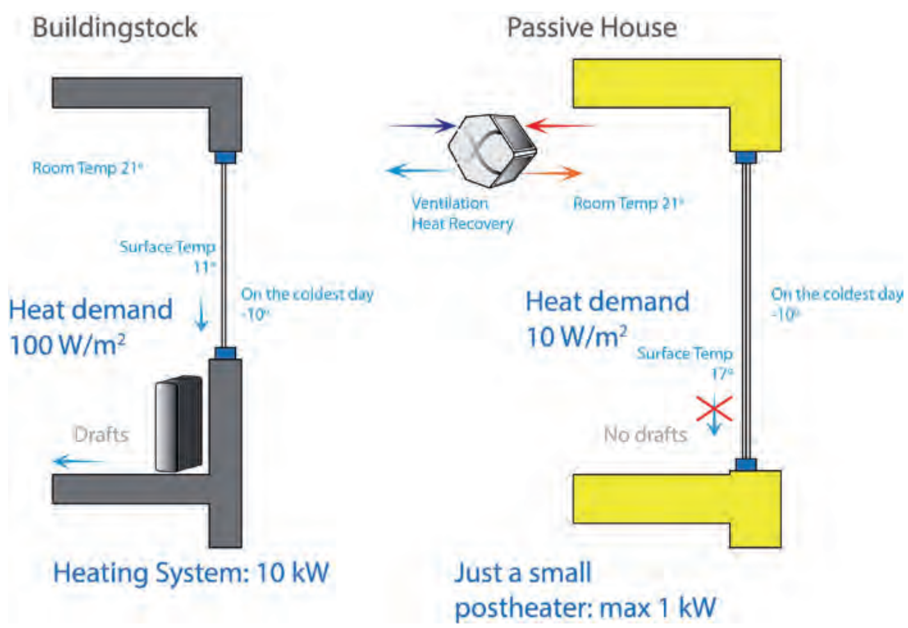
4. Air temperature
5. Surface temperature
6. Relative humidity
7. Air movement

A thermally uncomfortable building has consequences for the morale and performance of the people in it. Moreover, heating and cooling affects energy consumption. The PHPP (Passive House Project-calculation Package) pays much attention to aligning these factors.
Good insulation limits external climate influences. However, a window that lets in direct sunlight could be experienced as pleasant in winter while the same window should not let in sunlight in summer, to prevent overheating.

A **Passive House** ist a building, for which thermal comfort (ISO 7730) can be achived solely by postheating or postcooling of the fresh air mass, which is required to fullfill sufficient indoor air quality conditions (DIN 1946) - without a need for recirculated air.

This is the calculation to derive the "condition for Passive Houses":
From experience (and DIN 1946) we know, that 30 m^3/h is a minimum air rate per person to maintain a reasonable indoor air quality. Air has a specific heat capacity of 0,33 $Wh/(m^3K)$ (at 21°C). It is allowed to increase the fresh air temperature by 30 K, not more, to avoid pyrolysis of dust. You get 30 $m^3/h/Pers \cdot 0{,}33\ Wh/(m^3K) \cdot 30\ K =$ 300 W/Pers

That shows: 300 Watt per person can be delivered by a fresh air heating system.
If you have e.g. 30 m^2 living space per person, you get 10 W per m^2 living space.
This value is independend of the climate.
So far all values are peak load values, that is the maximum heat capacity needed at design conditions. In dependence of the external climate Passive Houses will have to be insulated to a different level: More insulation in Stockholm, less in Roma.



Air quality

The air quality is determined by two factors, namely the quality of the supplied air and the influence of the people, materials and equipment. In general, indoor air quality is worse than outdoor air quality. Ventilation with outside air is experienced as being fresh and comfortable. In a room, people produce CO2, water vapour and odour. In addition, the materials and equipment also emit harmful substances and annoying odours. It is important to extract these substances by using good ventilation. Ventilation of 25 m3/h per person is sufficient.

Acoustics

Sound surrounds us; the amount of sound and the way in which it reaches us determines the acoustic comfort. There is a different between noise and sound:
Noise is disturbing and unwanted, such as traffic noise. However, music, for example, can have a neutral or positive effect.

User adaptation

Research (Piet Vroon 1990) shows that people complain more about comfort when they have less influence on how it is controlled, especially climate control. The user wants to be able to open a window himself!
There are five psychological basic needs:

1. Change (in the surroundings and personal development);
2. Being able to influence the conditions in your surroundings;
3. A personal space (sphere of influence, also in the workplace);
4. Being able to give meaning to a sensory perception (smell, sounds, image, etc.);
5. Proximity or a view of nature.

If these basic needs are fulfilled, then the building is experienced as being pleasant.
If people can influence the comfort they experience indoors, it is important that the influence they exert has a directly visible or noticeable result.

Technical solutions cannot be introduced from the engineering side without adjustments being required on the mechanical side and vice versa. Comfort is not only the domain of installations and control units, it demands a holistic approach. No client will disagree with that, even so, many jobs are contracted separately to engineering and installation companies.

4.2 Integrated Company Policy

John Ruskin "Everything costs its own cost, and one of our best virtues is a just desire to pay it". In other words: It's unwise to pay too much, but it's worse to pay too little. When you pay too much, you lose a little money — that is all. When you pay too little, you sometimes lose everything, because the thing you bought was incapable of doing the thing it was bought to do. The common law of business balance prohibits paying a little and getting a lot — it can't be done. If you deal with the lowest bidder, it makes sense to add something for the risk you run, and if you do that you will have enough to pay for something better.

John Ruskin: Everything costs its own cost, and one of our best virtues is a just desire to pay it

Herein lies the crux of the transition from the current contracting culture: trust the other and work together. That cannot be arranged in a single day. The Bake house project shows that everyone has become so conditioned that they see bidding as the purest way of achieving an honest price. While in reality, it just heralds the start of bargaining and haggling. It only concerns the business and not the quality of the product from the consumer's perspective. How are you going to break this impasse while one half of The Netherlands is still bidding and the other half wants to cooperate based on trust?

Stable teams have been cooperating for a while in the refurbishment of bank buildings and in retail. A team that works together with the client. Three people from the refurbishment company, four people from the contractor in the region and a project manager ensure that the job is done. Ten branches in three months. They travel the country with the same assignment but are faced with a different situation at every location. They are well prepared by the project leader and the two planners from the two companies. The shop or bank building closes on Friday, is remodelled in the weekend and reopens on Monday afternoon.

Bake house in Erichem, passive house renovation

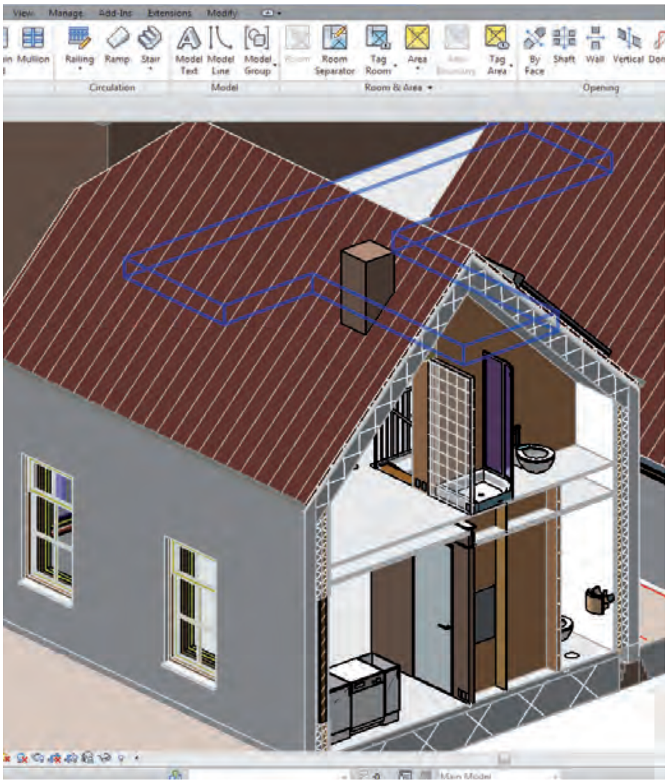
The client, Matthijs Heuff, would like to live on his parents' impoverished estate to keep it intact. Next to the large dwelling house, there is a bake house dating from around 1700 that is still in use as a kitchen. The idea of the client is to make this into a separate dwelling. The municipality of Buren, of which Erichem is a part, places requirements on habitation: the entire estate had to become a municipal monument so that a second dwelling (the Bake house) could be created to maintain the estate. The outside of the Bake house had to remain intact. The client was able to borrow € 90,000 from the bank for the renovation.
Initially, the client wanted to arrange the renovation via a contractor and have it be renovated traditionally. BouwQuest was also asked to submit an idea and together with the client came up with the idea of developing a sustainable and energy efficient solution, in keeping with the client's vision of sustainable reuse of the estate.

Passive house

The gas fire in the kitchen was always on. Matthijs Heuff was charmed by the idea of being able to dispense with the gas supply and in fact to heat his house with the energy available on his estate (pruning residues). Energy efficient renovation follows the Trias Energetica, therefore, energy saving first. The idea of a passive house appealed to Matthijs Heuff and revealed his level of ambition. Passive house requires less than 15 kWh/m2 per year to heat the house. This usually exceeds 100 kWh/m2 per year for existing houses. For the bake house, it was even higher. When renovating a building, this 15 kWh/m2 per year is not always achievable, especially if most windows face north as was the case here.

BIM model

Together with the client, a BIM model of the current situation was made at the kitchen table on a laptop. Measurements could be performed immediately and measurements from the model were checked. The idea quickly came to install a set of skylights in the south-facing roof to allow in the warm sun in the winter. The BIM model makes it possible to analyse the impact. It is even possible to calculate this to see when temperatures fall outside of previously specified boundaries. The simulation led to the idea of moving the stairs in the hallway, which led to the bedroom, to a location directly below the skylights in the living room. The spatial effect is huge! All of the possibilities were clearly visible.



No contracting

With the first model that recorded the ambition for the renovation, it was decided to approach a contractor with experience in passive building. Van der Maazen from Lith has experience with passive houses. Instead of having a list of requirements that could be costed, the client and contractor together examined how the ambitious result could be achieved within the available budget. The integrated approach allows different things to be considered than in a price negotiation. Together with the installer that Van der Maazen had collaborated with before, the full picture was elaborated. The supplier of the ventilation system and the supplier of the hot water solar boiler were integrated in the project organisation. Ideas to insulate the ground floor with foam concrete could easily be changed to using innovative Argex pellets and a thin concrete floor. This method reduces costs and achieves high insulation levels. The possibilities and impossibilities were discussed and dealt with. This allowed construction to be started quickly after the building permit was obtained.

Just before the contractor's contract was to be signed, acquaintances of Matthijs Heuff urged him to have another contractor quote for the project 'because it could surely be done cheaper'. People frequently voiced the opinion that the contractor's price was much too expensive. Not asking the competition to quote was 'really not done'. Even so, the client stood behind the process, because of the openness shown about how the price was reached. Now everyone thinks that it is a nice house and that Matthijs got value for money. A lack of imagination among Matthijs's acquaintances led to them falling back on the principle of bidding. In today's society, 'value for money' means 'bidding'.

Energetic renovation

The assignment is similar, the situation continually changes. There is a high degree of participation around a theme: energy neutral renovation. Autonomous teams consisting of the local architect/ engineer and the planners of the local contractor and installer visit the resident together. They sketch out a scenario in which the resident can participate. Within the team, the following applies:

- People and interaction take higher priority than processes and tools
- Proven experience is more important than imposing documents
- Cooperating with the client takes precedent over negotiating the contract
- Responding to change is more important than following the plan

This method of collaboration is also referred to as "Agile" working. This stems from the software development Agile Manifesto from 2001. The manifesto has 12 principles:

1. Client satisfaction through rapid interaction and arranging the extras.
2. 2Welcoming changing requirements, even late in development.
3. The client immediately sees the consequences of his request.
4. The team collaborates closely with people who have mastered energy-neutral renovation.
5. Projects are built around motivated individuals who can be trusted.
6. Face-to-face conversation is the best form of communication (co-location).
7. Appealing examples are the principle measure of progress.
8. Sustainable development, able to maintain a constant pace.
9. Continuous attention to technical excellence and good design.
10. Simplicity, the art of maximising the amount of work not done, is essential.
11. Self-organising teams.
12. Regular adaptation to changing circumstances.

Jos de Blok with Buurtzorg
The Buurtzorg (neighbourhood care) formula
Buurtzorg Nederland has developed a new concept for nursing and care in the home. Care where we strive to achieve better solutions for the client, solutions that are sustainable and effective. Neighbourhood care is provided through fully trained neighbourhood nurses and caretakers who work in small autonomous 'Neighbourhood Care teams'. This approach uses the problem-solving skills and professionalism of the workers to the full. These Neighbourhood Care teams are supported by a national organisation. Use is made of modern ICT applications that minimise administrative costs. Management and overhead costs are kept to the minimum. In short: better care at a lower cost; an appealing perspective for the client, the carer and the insurer.

To help the team, each project is divided into sub-problems with sub-solutions, which are worked on by the different members of the team. The different projects are talked through almost daily with the following questions being posed to each team member:

- What have you done?
- What are you going to do?
- What are the problems?

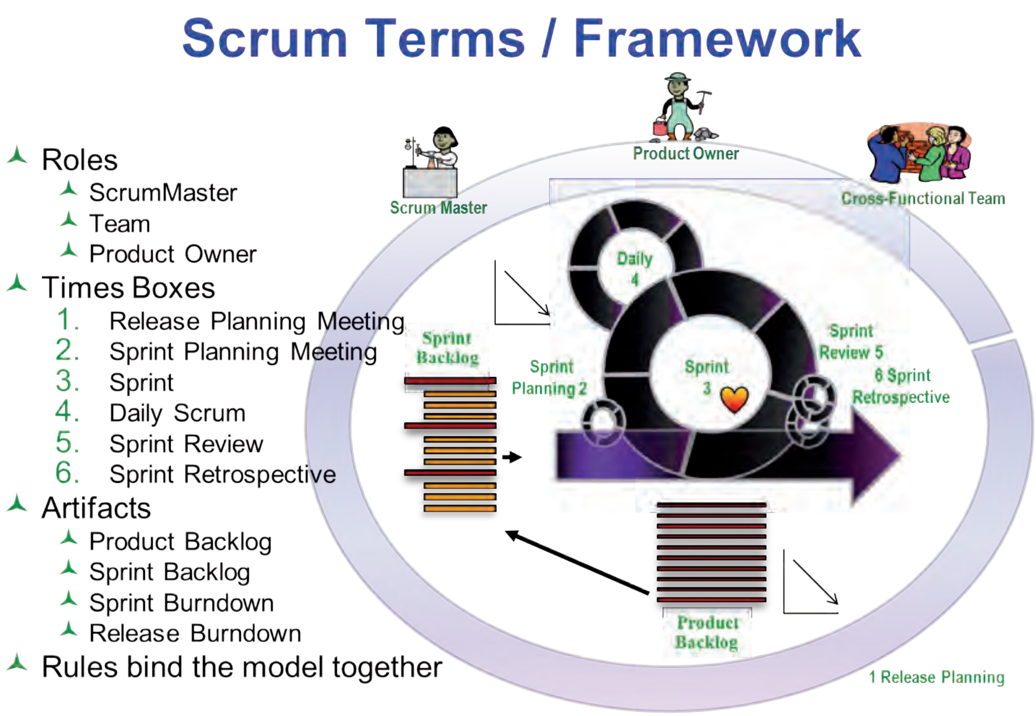
This session takes no longer than 15 minutes. The so-called "stand-up meeting" is led by a manager who does not lead the team, but is only there to ensure that the team reaches its targets. The targets are:

- Increasing the effectiveness of the team.
- Monitoring the progress of the team.
- Overcoming obstacles.
- Monitoring the progress of the project.
- Mapping out and minimising the risks.

The method is called "Scrum" and the manager is called the "Scrum Master". Every renovation project is divided into "sprints" that are characterised by the following steps:
What does the client want?
Are all the requirements of the client possible?
Design.
Can it be built and easily worked out?
Building application.
Detailed elaboration.
Rapid realisation.
Monitor whether everything works.

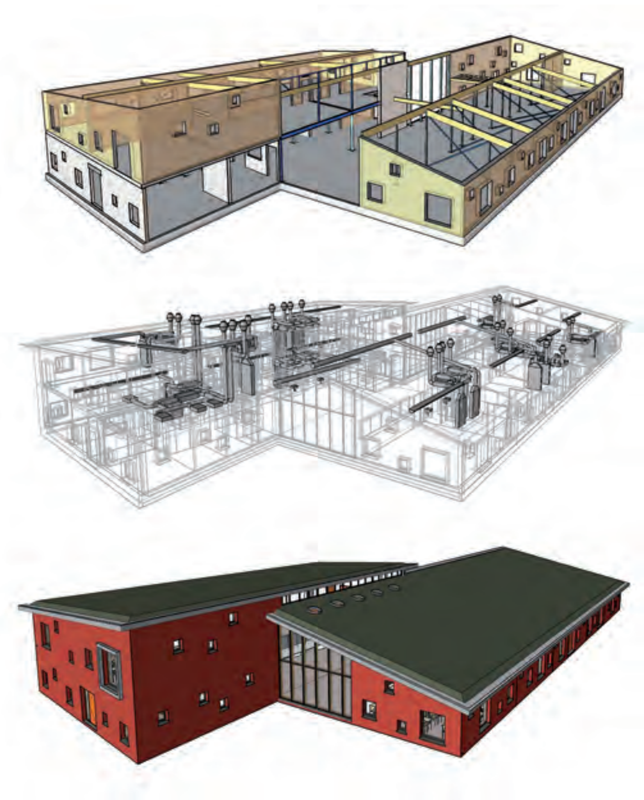
In fact, this resembles the eight systems engineering steps, but without the administration required for verification and validation. The architect or engineer tries to represent the client as well as possible, but is still a member of the team. He or she is not an extension of the client, which is currently standard practice. The architect is contracted by the team and just like the other team members he or she is employed and receives a bonus based on the profit made.

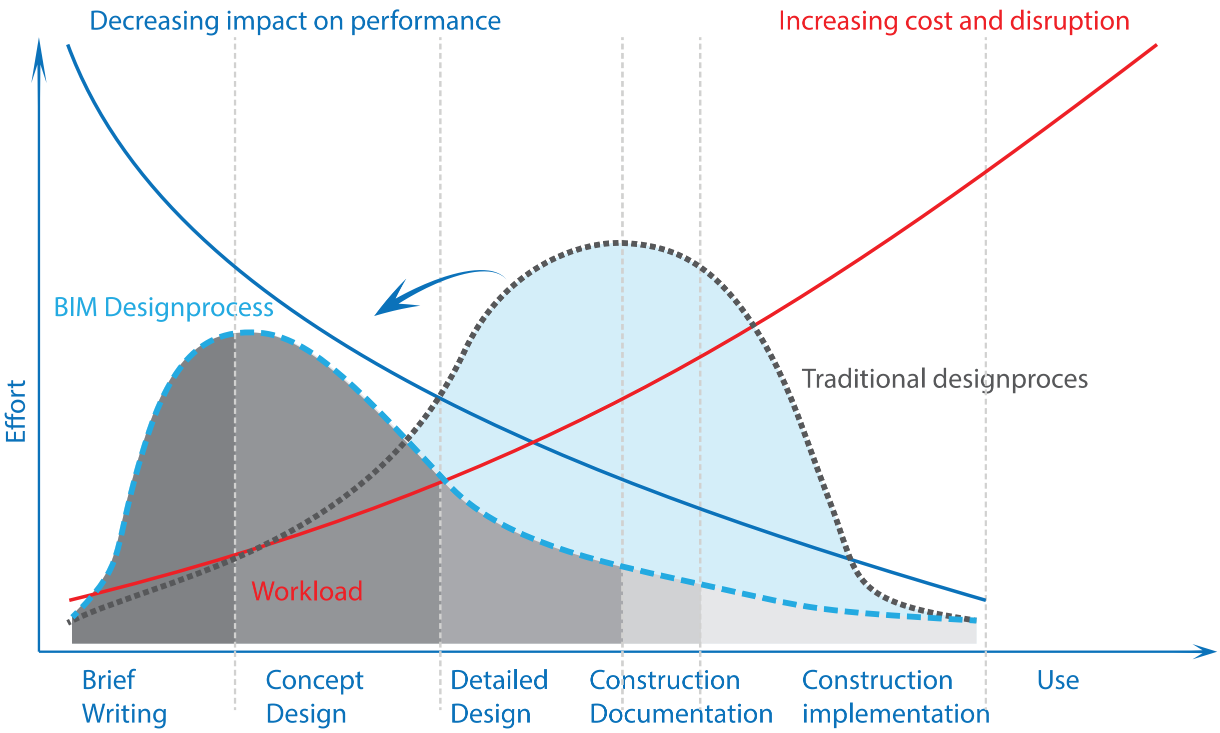
The first projects need to be intensively supervised to introduce innovation into the team. This is a good way to persuade the early majority to introduce the innovation (which was adopted earlier by early adaptors) into daily practice. This is because daily practice within SME companies hardly differs from that sketched out above, but then fragmented in their own company. This gets in the way of energetic renovation, which can only be solved in an integrated way with all disciplines.



4.3 Integrated information sharing

The use of new information and communication technology in building leads to major changes in the way in which buildings are designed and built. Project partners (clients, architects, consultants, contractors) work together via electronic communication platforms (project websites), where all the project information is saved and managed centrally. 3D modelling packages allow for efficient and consistent drawings, lists and specifications of building projects. The advanced software allows for a lot of non-geometrical information to be added to a model and 'enrich' it to make it a BIM. A BIM can be defined as a digital model of the building, in which all relevant information regarding functional and physical characteristics is saved, managed and accessed. The BIM is shared by multiple stakeholders in the building process. The core of a BIM is a 3D building model that consists of multiple 3D aspect models per discipline. All parties involved work via the BIM with the same information, which is continually available and always up to date. The information in a BIM is the starting point for (and is supportive to) activities and decision making throughout the lifecycle of the building. For example, a BIM can be used to visualise the design in three dimensions, and to simulate and analyse the "behaviour" of the future building. Connecting the 3D model to a plan can allow the implementation process to be simulated. The potential possibilities are wide-ranging and the impact on collaboration in the building process extensive.





When compared to the traditional design process, the design efforts in the BIM design process focus more on the early phases (where there are a relatively large number of opportunities to influence value for money and where the cost of design changes are relatively low).

The information flow that is required to collaborate efficiently is dependent on the contract. The diagrams that are added to the protocol clearly show that a traditional contract allows for less information sharing than that offered by an Integrated Project Delivery (IPD) organisation model.

The book "BIG BIM little bim - The practical approach to Building Information Modelling - Integrated practice done the right way!" by Finith Jernigan, addresses different techniques and tools that can help the team to collaborate efficiently. These tools are elaborated on in the BouwQuest-Spekkink IPDP guide in such a way that they can be used practically:

- Enrich the BIM models per phase and reuse the rich information in each phase of the project (in other words: input as much information once and reuse it, rather than re-inputting the same information for each phase or rebuilding the model);
- Keep the project information up to date and available in the different phases of the process (initiation, design, planning, quoting/procurement, implementation and exploitation);
- Provide analysis instruments in order to provide timely insight into 'clashes' between elements such as supporting beams and air ducting, the manufacturability of the building, the construction costs, the energy consumption, the indoor climate, etc.;
- Such analyses can help the project team to make well-founded decisions about material use, energy and installation concepts, sustainability, etc. They can also help to prevent alignment problems during implementation.
- Use open communication platforms such as central Document Management Systems (DMS) and/or project websites, where team members can share project information in a structured way and that offer additional functionality for supporting the team process.

The protocol that aligns the information structure in advance can be found in the Appendix.

The diagrams clearly show that with a traditional contract there is much less information shared beforehand than when there is an open relationship such as offered by the Integrated Project Delivery (IPD) organisation model .

Implementation of BIM for the whole project (BIG BIM) requires those involved in the project to take a different attitude than that taken in the traditional process. In "BIG BIM little bim" Jernigan formulates seven "rules" for this:

1. Be self-aware and know your own work.
2. Do not linger too long when faced with a failure or a faulty process.
3. Involve others sooner in the process, focus on collaboration.
4. Increase the knowledge and productivity at the beginning of the project.
5. Adapt the fee to the changed procedure.
6. Manage the responsibilities and risks.
7. Improve quality and productivity.

This is also an iterative process where the risks are reduced every time people work together in a subsequent project. There are already many companies that have formed alliances with other companies following this principle.


SMIT'S BOUWBEDRIJF BV

DOCUMENTATIE "BIG BIM"

HET SAMENWERKEN IN EEN BIM MODEL

Smit's Bouwbedrijf   versie 1.0 (12-04-2012)   1

Tasks

Start working. Don't attend another congress or lecture, but start working in three areas.

1 Integrated designing
2 Integrated information flow
3 Company policy

In other words, morphological designing with the entire team, consisting of the client, the designers and the builders. Use BIM and develop a different process. As already indicated, everything focuses on serially developing individual projects. Because in the future, the majority of building projects will focus on renovation to reduce energy use, change of use and the use of existing open spaces in the city. Moreover, the serial aspect of building is no longer found in the number of buildings built but in the serial approach taken to building by a permanent team, the members of which know each other through and through and who successfully tackle jobs together.

Smit's Bouwbedrijf has formed an alliance with a few other companies. In these alliances, they have identified each other's added value and have made agreements on information transfer in the IPD protocol. That companies find partners before commencing a project is relatively new. There are companies that have always done this, but then for similar projects. The approach is rarely found in areas where the projects change in type and size.

5. In conclusion

Integrated designing and building is not out of reach, and is not difficult to apply in practice. Put theory into practice and enter into new forms of contract and alliances. Start working! Techniques for integrated thinking with respect to technology, process and information are available. Do not give another lecture or explain everything again, write 'best practices' or establish roadmaps.

There is no point. Personal contact and working together is the creed. It is not the motives behind a sustainability mandate (making the neighbourhood sustainable, or the large-scale roll out of passive houses in The Netherlands) that are important but your own personal motive and the responsibility of each partner are the guiding principles in the organisation or network.

Ask the following questions:
And you?
What is your motivation?
Where do you want to be in 5 years?
What is your first step?
What do you want to do and what makes you happy?
What do you find challenging?
Can we help you?

Start small, it will develop into the new big.

PassREg

Co-funded by the Intelligent Energy Europe
Programme of the European Union

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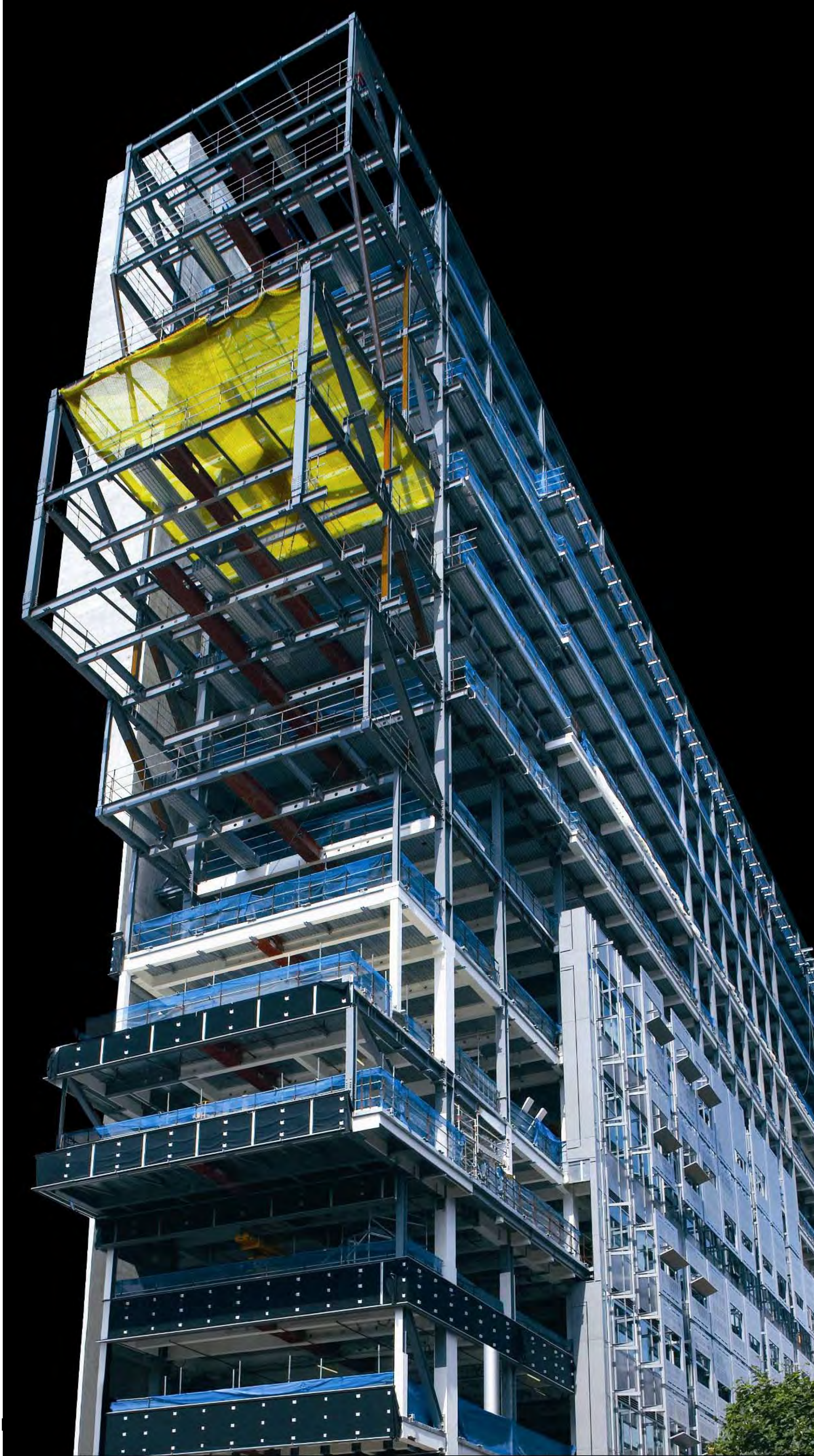
Apendix

Workflow Communication Protocol Autodesk 2008



BIM Communication Specification®

Autodesk

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IMPORTANT – PLEASE READ

Published by:
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San Rafael, CA 94903, USA

Executive Summary

In today's architecture, engineering, and construction (AEC) industry, new technologies and practices are making a significant difference in how building projects get delivered. Owners, architects, and contractors are using collaborative communication platforms to manage and share information and standardize their business processes. Meanwhile, advanced model creation tools let stakeholders visualize, simulate, and analyze how a building might behave, perform, or appear—with more precision than ever before.

But the plethora of new tools, technologies, and practices may seem confusing. To help users navigate and take advantage of the savings in cost and time these tools can offer, we have created this document.

The BIM Communication Specification outlines practices and provides a framework for using building information modeling (BIM) technology and practices to deliver projects faster and more cost-effectively.

Filled with information and planning templates to streamline project communications, it focuses on helping you reduce design and construction costs through collaborative communication. By using this document as a collaborative, adaptable template to establish project standards and responsibilities from the start, you'll ensure that all stakeholders get the information they need during every phase of the building project.

Table of Contents

I. Overview

In recent years, technologies and practices have emerged that fundamentally change how building projects get delivered - These technologies range from new tools for model creation to the use of visualization, simulation, and analysis tools to better predict a building's behavior, performance, or appearance. In addition, collaborative communication platforms are being used to manage and share information and drive business process standardization.

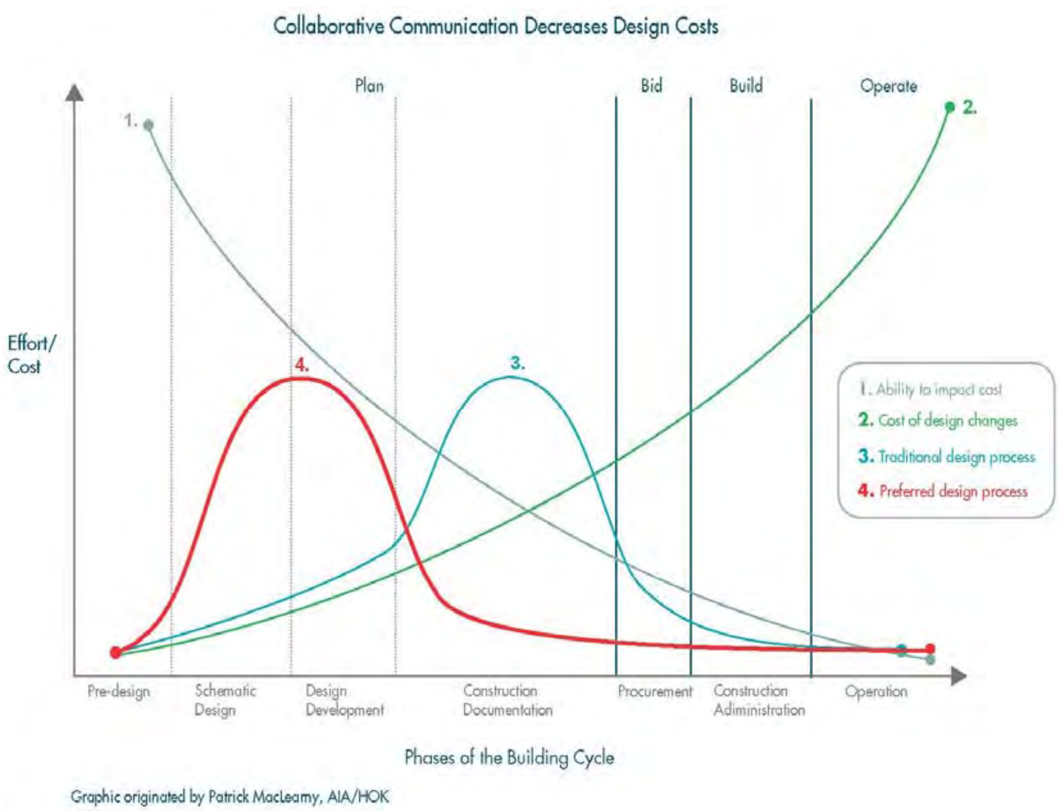
The intent of this BIM Communication Specification document is to provide a framework that lets owners, architects, engineers and contractors deploy building information modeling (BIM) technology and best practices to deliver their projects faster and more cost-effectively. This document also makes recommendations on the roles and responsibilities of each party, the detail and scope of information to be shared, relevant business processes and supporting software.

For stakeholders in building projects, the benefits of applying the framework and recommendations include:

- Improved communication and collaboration among all project team members
- Fewer problems related to overruns in cost, schedule, and scope, or quality concerns
- Being able to reliably deliver projects faster, more economically, and with reduced environmental impact.

BIM technology helps builders ensure that project knowledge remains accessible continuously throughout the different phases—planning, bidding, building, and operating—of any construction project. But before they deploy BIM technology, builders need information on how to streamline their communications and select the right tools.

Autodesk created this BIM Communication Specification to help guide companies like yours through the process. It helps you define project teams, indentify key processes and dependencies throughout your project, assign roles and responsibilities, and select software solutions that use collaborative communication to reduce your project costs.



In this document, we establish a planning framework for your building projects, and provide information about different kinds of technology that can help you work more efficiently:

1. Solutions that let project teams create, adapt, and reuse information-rich digital models during every stage of the project, including design, construction, and operations.
2. Analysis tools that deliver insight into the constructability and potential performance of buildings before they are built. Using this analysis, your project teams can make more informed decisions about building materials, energy, and sustainability—and detect and prevent costly clashes between elements such as pipes and beams.
3. A collaborative communication platform that helps reinforce business processes while ensuring that all team members share project information in a structured manner.

With these solutions, you can keep BIM data intact throughout all phases of development. At the beginning of a project, the team can work together to resolve design problems before they break ground. When the project is completed, the team can present the building owner with a complete digital model that provides all the information necessary to manage and operate the building—instead of delivering unwieldy rolls of drawings and boxes of paper documentation.

Your project teams can use the BIM Communication Specification as a collaborative, working template for establishing project standards and alignment early in the project. The BIM Communication Specification will also help your teams define the roles and responsibilities for each team member, what types of information to create and share, and what kind of software systems to use and how to use them. Your project teams will be able to streamline communications and plan more effectively—reducing costs as well as concerns about quality, scope, and schedule across all phases of construction.

II. Project Initiation

In this section you'll define your Core Collaboration Team, as well as your project objectives, project phases, and overall communication plan throughout the project's phases.

A. Project Description

Enter key information about the project below. Include the project name, the owner's project number, the address, and the project description.

Project Name	
Owner's Project Number	
Project Address	
Project Description	

B. Core Collaboration Team

Your project's Core Collaboration Team ideally includes at least one person from each stakeholder involved in the project, such as the owner, architect, contractor, sub-consultants, suppliers, and trade contractors. This team is responsible for:

- Completing this BIM Communication Specification,
- Creating the document management file folder structure and permission levels in the collaborative project management system
- Enforcing the action plan set out in this document throughout the design and construction of the project.

To complete this BIM Communication Specification, the Core Collaboration Team on your project will:

- List the goals and objectives of using BIM and collaborative project management technologies on your project
- Specify the project's phases/milestones
- Map out the communication among project team members for the different project phases.

List the Core Collaboration Team members for your project below.

Contact Name	Role / Title	Company	Email	Phone

C. Project Goals and Objectives

Using collaborative project management and BIM technologies on projects can offer tangible as well as intangible benefits. List your objectives for using BIM and collaborative project management technology and processes on this project below. Also list how you will measure the achievement of these objectives, and their targeted timeframes. The first line shows an example.

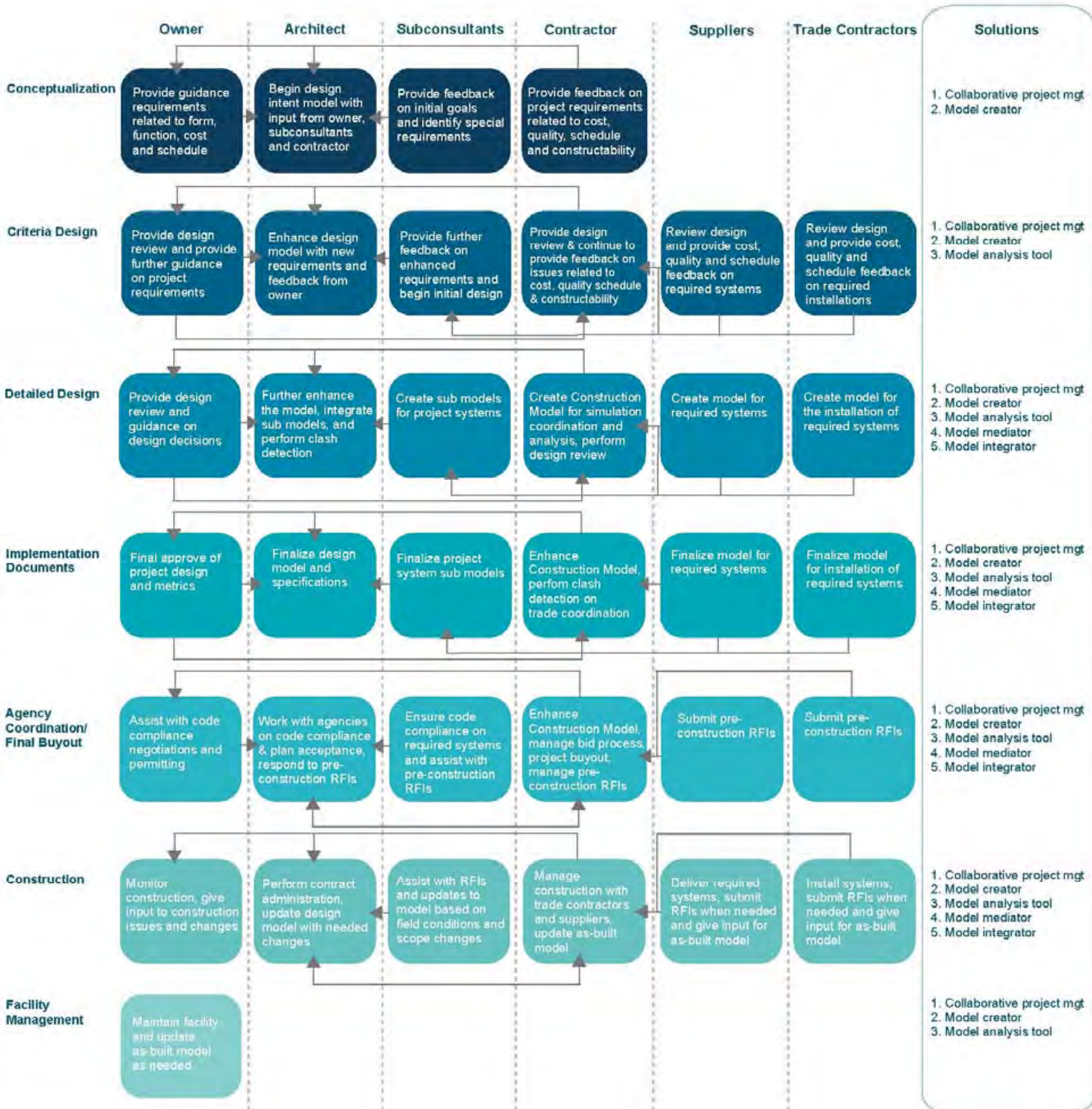
Project Goal	Objective	Achieved if	Projected Timeframe
Streamline structural steel procurement	*Include the steel supplier in the modeling process in order the start fabrication earlier*	*Steel is ready and delivered to site when needed*	*April, 2010*

D. Collaborative Process Mapping

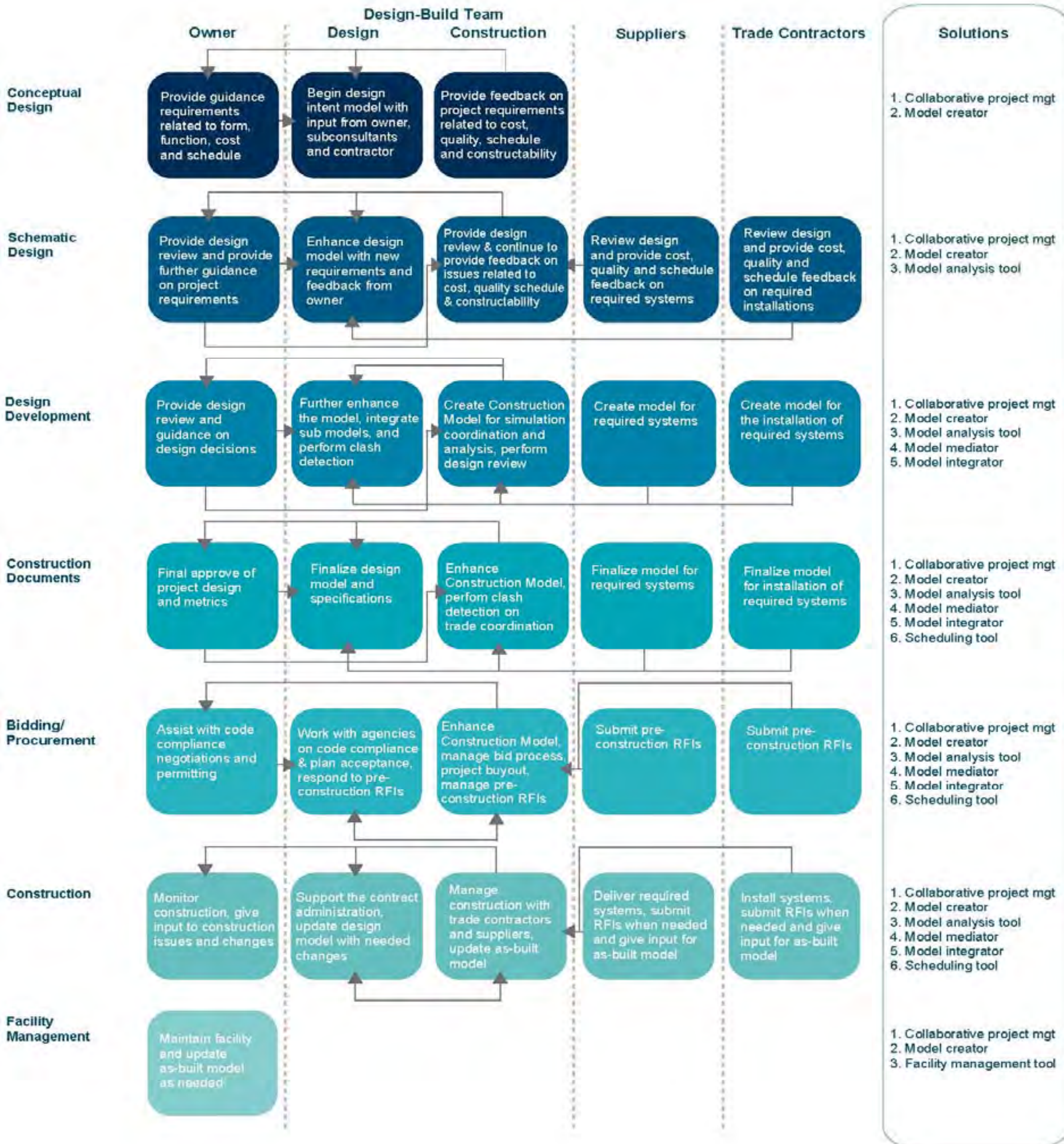
To get the most out of your collaborative project management and BIM initiatives during your project, we recommend investing a bit of time up front to map out anticipated collaboration between team members on the project during its different phases.

As an example, a typical collaboration plan is shown below for three different project delivery methods—integrated project delivery, design-build project delivery, and design-bid-build project delivery. Use the blank chart following the example charts to enter your project's delivery method and collaboration plan. The resulting process map should show the phases of your project along the *y* axis, the stakeholders involved in each phase along the *x* axis, the anticipated collaboration between project team members in the textboxes, and the software solutions to be used in the last column.

Integrated Project Delivery



Design-Build Project Delivery



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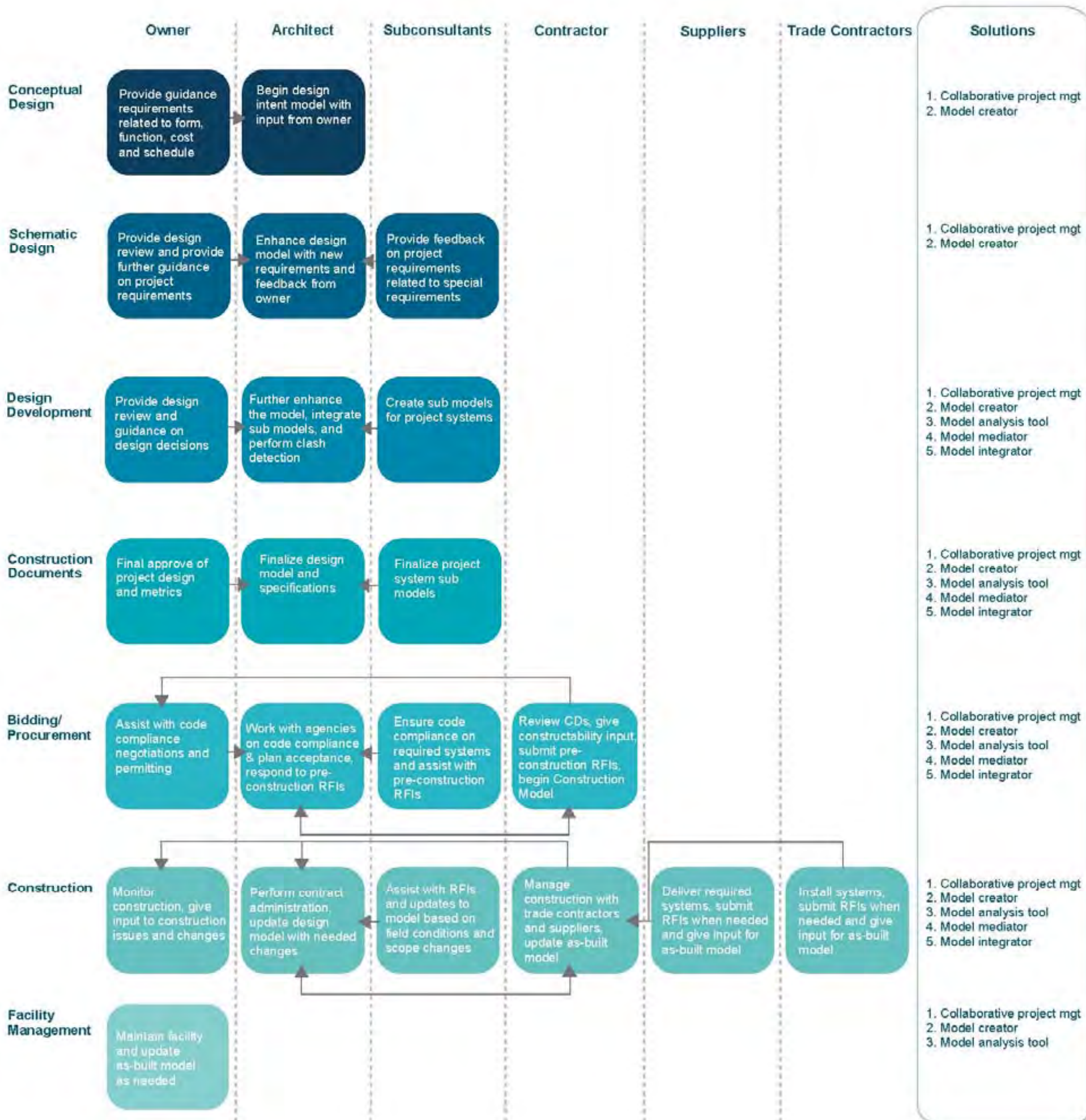
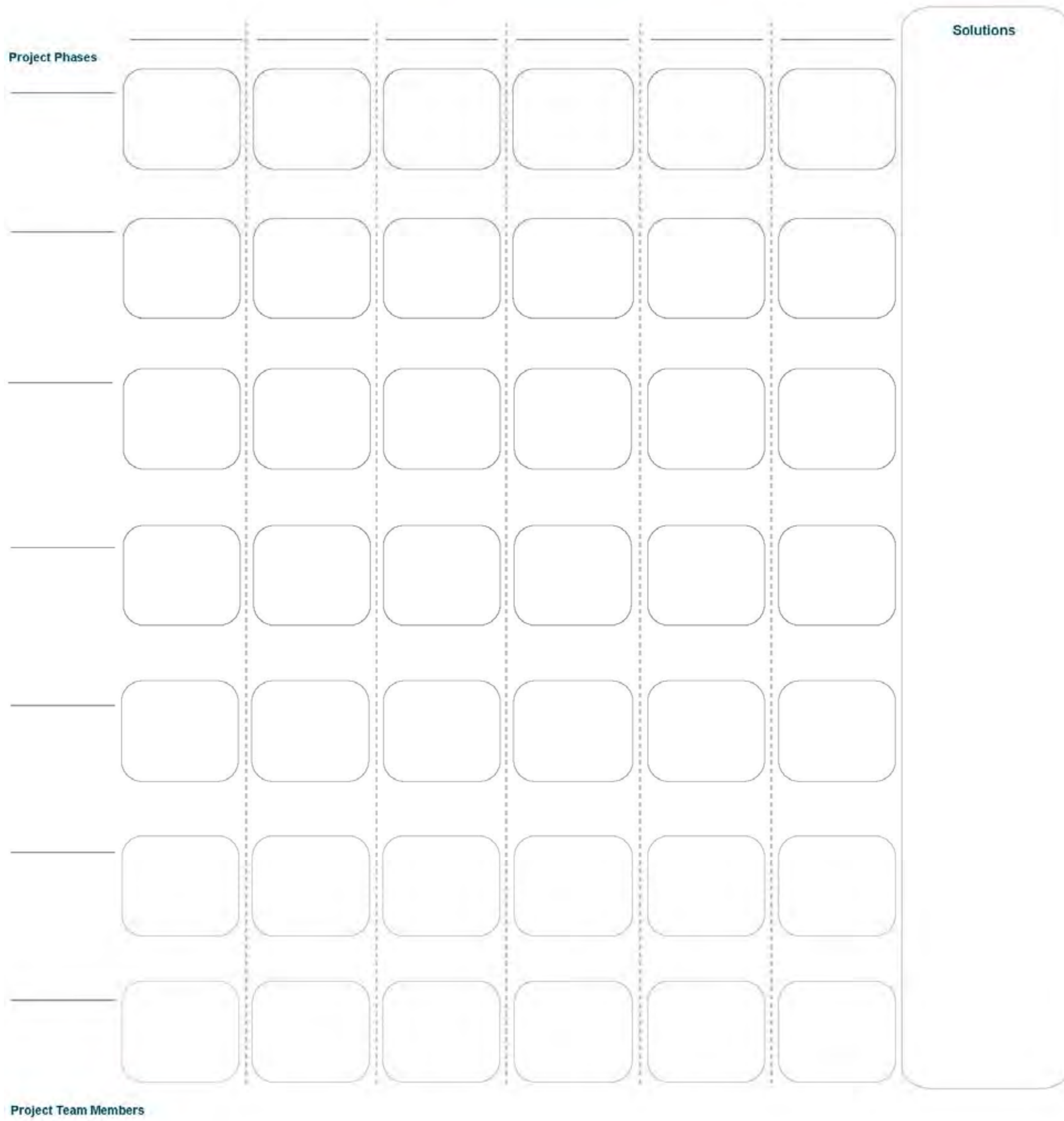
Design-Bid-Build Project Delivery



Use the blank chart below to create your project's collaboration plan. The process map should show the phases along the *y* axis, the stakeholders involved in each phase along the *x* axis, the anticipated collaboration between project team members in the text boxes, and software solutions to be used in the final column.

Project Collaboration Plan



E. Project Phases / Milestones

Traditional project delivery includes the phases of schematic design, design development, construction documents, construction operations, etc. Integrated project delivery (IPD) phases may include conceptualization, criteria design, detailed design, implementation documents, and others. For more information on IPD project phases, see the American Institute of Architects publication, *Integrated Project Delivery: A Guide, 2007* (available at www.aia.org/ipdg).

In the table below, outline the phases of your project, their estimated start dates, and the stakeholders involved. The first line shows an example.

Project Phase / Milestone	Estimated Start Date	Estimated Completion Date	Project Stakeholders Involved
Conceptualization	*2/1/2008*	*4/1/2008*	*Owner, A/E, Sub-consultants, CM*

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III. Modeling Plan

Advance planning around which models will need to be created during the different phases of the project, who will be responsible for updating models and distributing them, and predetermining the content and format of models as much as possible will help your project run more efficiently and cost-effectively during every phase.

A. Model Managers

Each party—such as the owner, architect, contractor, or sub-consultants—that is responsible for contributing modeling content should assign a model manager to the project. The model manager from each party has a number of responsibilities. They include, but are not limited to:

- Transferring modeling content from one party to another
- Validating the level of detail and controls as defined for each project phase
- Validating modeling content during each phase
- Combining or linking multiple models
- Participating in design review and model coordination sessions
- Communicating issues back to the internal and cross-company teams
- Keeping file naming accurate
- Managing version control
- Properly storing the models in the collaborative project management system

List the model managers for the project in the table below.

Stakeholder Company Name	Model Manager Name	Email	Phone

B. Planned Models

During the course of your project, the project team may generate multiple models. Typically the architect and their sub-consultants generate a Design Intent model to depict the design intent of the building, and the contractor and their subcontractors generate a Construction model to simulate construction and analyze the constructability of the building. The construction team should provide input for the Design Intent model, while the design team should provide input for the Construction model.

Even when the team is committed to using integrated project delivery (IPD) methods, creating separate models is sometimes necessary based on contractual obligations, risk factors, and the functional intent of each model. For example, the Design Intent model—used to depict the design intent—may not include information on the means and method or sequencing of construction. Other models may be created specifically for certain types of analysis, such as energy consumption or safety. These Analysis models are usually spin-offs of either the Design Intent model or the Construction model. Analysis models will be specified further in *Section IV* of this document, which covers Analysis models and planning.

In the table below, outline the models that will be created for the project. List the model name, model content, project phase when the model will be delivered, the model's authoring company, and the model authoring tool that will be used. For models that will not be used or created in your project, just leave the row blank, and add rows for model types you anticipate needing that are not already listed. The first line offers an example.

Model Name	Model Content	Project Phase	Authoring Company	Authoring Tool
Coordination Model	*Architectural, Structural, and MEP components of main building and parking garage structure*	*Design Development and Construction Documents*	*ABC Designers*	*Revit Architecture by Autodesk*
Civil Model				
Architectural Model				
Structural Model				
MEP Model				
Construction Model				
Coordination Model				
As-Built Model				

C. Model Components

As an aid to usability during later phases of your project, specify what the content, level of detail, and file naming structure of your models should look like.

i. File Naming Structure

Determine and list the structure for model file names. The first line offers an example.

File Names for Models Should Be Formatted As
model type, hyphen, date, e.g.: DESIGN-011208

ii. Precision and Dimensioning

Models should include all appropriate dimensioning as needed for design intent, analysis, and construction. With the exception of the exclusions listed below, the model will be considered accurate and complete. In the table below, enter which items' placement will not be considered entirely accurate and should not be relied on for placement or assembly.

Items that Will Not Be Considered Accurate for Dimensioning or Placement

iii. Modeling Object Properties

The level of property information in the modeling objects and assemblies depends on the types of analysis that will be performed on the model. See *Section IV-A (Analysis Models)* for the types of analysis that will be performed.

iv. Modeling Level of Detail

Specify the level of detail in your models below. The level of detail can be defined by exclusions and/or by object size.

1. **Exclusions:** List the objects that will be excluded from the model in the table below. The first line offers an example.

Items that Will Be Excluded from the Model
Door hardware

2. **Size:** Any object smaller than [________] *(Fill in item size, for example, 6"x6"x6")* will not be included in the model.

v. Model Reference Coordination

Models may be linked or combined. In order for the referencing to work properly, a (0,0,0) reference point must be established. Fill in the (0,0,0) reference point for this project in the table below.

Project's (0,0,0) Reference Point	

D. Contract Documents

Two-dimensional paper drawings or documents may be generated from certain models to fulfill contract document deliverable requirements. Certain models will be used for analysis purposes only and will not be included as part of the contract documents. List the models that will be considered part of the contract documents in the table below.

Models to Be Considered Part of Project Contract Documents

E. Detailed Modeling Plan

For each phase of the project, the project team should create a detailed modeling plan, which should include the modeling objectives, models included, and the roles and responsibilities of model contributors. Model objectives and model manager roles and responsibilities by phase are outlined below.

i. Conceptualization / Conceptual Design

1. Objectives: Provide initial design based on conceptual parameters established by the owner, ensure that code and zoning requirements meet project objectives, establish a 3D reference point of model coordination. [*List further objectives if needed.]*
2. Model Roles: A model may or may not take shape during the Conceptualization/ Conceptual Design phase. If a model is created, its role will be to depict the visual concept and general layout of the project. [*List further roles if needed.]*
3. Responsibilities: The architect's designated model manager will establish a baseline model to be used as the basis for other models. During the Conceptualization phase, the model managers from all parties will establish modeling standards and guidelines. [*List further responsibilities if needed.]*

ii. Criteria Design / Schematic Design

1. Objectives: Provide spatial design based on input from the Conceptualization/Conceptual Design phase; provide initial design for building system and attributes including architectural, structural, and MEP; identify initial coordination issues between building systems; receive input from suppliers and fabricators regarding system cost, placement, fabrication and scheduling. [*List further objectives if needed.]*
2. Model Roles: The Architectural model will show the general design and layout of the building structure and act as the baseline for all other subsystem designs, such as MEP and Structural models. The subsystem designs will be used to show the initial selection and layout of building components. The combined Coordination model will show the spatial relationship of the Architectural model and subsystem design models. [*List further roles if needed.]*
3. Responsibilities: Once the baseline conceptual structure has been created, the architect's model manager will send the model to the sub-consultants so they can develop their designs. The sub-consultants' designated model managers will audit and deliver the completed models to the architect's model manager. The architect's model manager will review the models to ensure compliance with the phase requirements. Once the models meet the requirements, the architect's model manager will link or combine cross-disciplinary models. The architect's model manager should also eliminate duplicate or redundant objects, and accurately name the Coordination model and store it in the collaborative project management system. [*List further responsibilities if needed.]*

iii. Detailed Design / Design Development

1. Objectives: Provide final design of building and building systems; resolve coordination issues between building systems; provide a Construction model capable of analyzing schedule, cost, and constructability; provide Fabrication models to analyze the coordination of trades. Once the final design decisions have been made, the architect's model manager will send the Coordination model to the sub-consultants so they can finalize their designs. [List further objectives if needed.]
2. Model Roles: The Architectural model will continue to act as the baseline for all other subsystem designs. The subsystem designs will be modified accordingly to represent the enhanced design. The combined Coordination model will continue to show the spatial relationship of the Architectural model and subsystem models. [*List further roles if needed.]*
3. Responsibilities: The sub-consultants' model managers will use the Coordination model to revise and complete their designs. Once the models are complete, the sub-consultants' model managers will deliver their models to the architect's model manager. The architect's model manager will review the models to ensure compliance with the phase requirements. Once the models meet the requirements, the architect's model manager will link or combine the multiple models to update a new Coordination model. The model manager should also eliminate duplicate or redundant objects. The architect's model manager will deliver the Coordination

model to the contractor's designated model manager. The contractor will use the Coordination model for the basis of the Construction model. [*List further responsibilities if needed.]*

iv. Implementation Documents / Construction Documents
1. Objectives: Finalize design of the building and all building systems, prepare documentation for agency review, and provide construction modeling that highlights constructability, trade coordination, and fabrication. [List further objectives if needed.]
2. Model Roles: All design models will be used to reflect the final design. The models will then be used to generate the contract documents. The Construction model will be used primarily for estimating, scheduling, and constructability analysis. [*List further roles if needed.]*
3. Responsibilities: The architect's and sub-consultants' model managers will prepare contract documents for agency review based on the Coordination model. The contractor's model managers will send the baseline Construction model to the suppliers and subcontractors. The suppliers and subcontractors will submit Fabrication models, which replace traditional "shop drawings." The contractor's model manager will incorporate these models into the Construction model. [*List further responsibilities if needed.]*

v. Agency Coordination / Bidding
1. Objective: Revise Coordination model based on agency feedback and finalize Construction model. [List further objectives if needed.]
2. Model Roles: The design models will be adjusted to reflect agency feedback. The Construction model will be enhanced and further used for estimating, scheduling, construction sequencing, trade coordination, and constructability analysis. [*List further roles if needed.]*
3. Responsibilities: The architect's model manager will communicate agency comments back to the design team. The sub-consultants' model managers will revise their design models accordingly and submit them back to the architect. The architect's model manager will update the final Coordination model. [*List further responsibilities if needed.]*

vi. Construction
1. Objectives: Update Coordination model based on submittals, RFIs, or owner-directed changes; maintain the Construction model based on construction activities, develop an As-Built model to reflect the actual fabrication of the building. The construction team will submit RFIs and submittals through the collaborative project management system. [List further objectives if needed.]
2. Model Roles: The Coordination model will be revised throughout construction, based on owner directives and unforeseen conditions. The model will always reflect the revised contract documents. The Construction model will be used for scheduling analysis, construction sequencing, and trade coordination. The As-Built model will be used to represent the actual assembly of the building(s). [*List further roles if needed.]*
3. Responsibilities: The architect's model manager will work with their consultants to answer the RFIs and submittals and adjust the Coordination model accordingly. The contractor's model manager will update the Construction model and will work with the suppliers and subcontractors to develop an As-Built model. [*List further responsibilities if needed.]*

vii. Facility Management
1. Objective: Use the As-Built model for facility management, update the model based on ongoing operations. [List further objectives if needed.]
2. Model Roles: The As-Built model will be used to represent the actual assembly of the building(s) from construction. The model can be updated further and used to show construction changes and facilitate the operation of the facility. [*List further roles if needed.]*
3. Responsibilities: The facilities management model manager will update the model based on ongoing operations. [*List further responsibilities if needed.]*

IV. Analysis Plan

By listing and specifying what types of analysis your project will likely require at the beginning of your project, you can ensure that your key models will include the relevant information, making the analysis easier and more efficient.

A. Analysis Models

Your project's scope of work may require performing certain kinds of analysis, such as the ones listed below, based on existing or specially created model(s). In most cases the quality of the analysis depends on the quality of the original model that the analysis is derived from. Therefore the project team member performing the analysis should clearly communicate the analysis requirements to the original model authoring team member.

i. Quantity Takeoff Analysis

The objective of quantity takeoff analysis is to use modeling property data to automate or simplify the quantity takeoff process. This information from the quantity takeoff tool can then be imported or tied to cost-estimating software. In order for the quantity takeoff process to work seamlessly, the original modeling author will need to include the relevant property information in the design.

ii. Scheduling Analysis

Scheduling analysis lets the project team use the project model to analyze the timeline and sequencing for construction. This information can then be used to modify or adjust the construction schedule. Tools currently exist that allow project team members to visualize the construction over time, but no systems exist yet that interact automatically with scheduling tools.

iii. Clash Detection Analysis

Clash detection analysis is done to check for interferences between the designs of one or many models. To reduce change orders during construction, clash detection should be performed early and continue throughout the design process. For clash detection to work properly your project's models need to have a common reference point and they must be compatible with the clash detection tool.

iv. Visualization Analysis

Visualization tools let the project team view the design or construction of the project in 3D, giving them a more accurate perspective of the end product.

v. LEED Rating/Energy Analysis

LEED (leadership in energy and environmental design) Rating/Energy Analysis tools help the project team evaluate the impact of design decisions on sustainability and energy consumption. This analysis model is usually based on the main Architectural model, after which material and building system inputs can be used to evaluate the project's sustainability and energy consumption.

vi. Structural Analysis

Structural analysis tools use the model to analyze the building's structural properties. Structural analysis programs typically use the finite element method (FEM) to measure the stresses on all structural elements of the design. For structural analysis to work seamlessly, the original structural modeling tool needs to be compatible with the structural analysis tool, and the original structural model property data must include information about the structural elements.

B. Detailed Analysis Plan

For each type of analysis that may be performed for your project, list the models used for the analysis, which company will perform the analysis, the file format required for the analysis, the estimated project phase, and the analysis tool that will be used. If there are other special instructions associated with the analysis, mark the Special Instructions column and list the details in the Special Instructions table in the next section. The first two lines in the table below show examples.

Analysis	Analysis Tool	Model	Analyzing Company	Project Phase(s)	File Format Required	Special Instructions
Visualization						
Structural						
Clash Detection						
Quantity Takeoff						
Scheduling / 4D						
Cost Analysis / 5D						
Energy/LEED						
Daylight/Lighting						

i. Special Instructions

Certain types of analysis may call for specific requirements or instructions. The company performing the analysis should communicate these special requirements to the original model authoring company. List these specific requirements in the table below. The first line shows an example.

Analysis Requiring Special Instructions	Detailed Special Instructions

V. Collaboration Plan

Creating a collaboration plan early on—including defining permissions and file structures—will help team members efficiently communicate, share, and retrieve information throughout the project. It lets you get the most out of your collaborative project management system, saving time and increasing your ROI.

A. Document Management

You can create a file folder structure in your collaborative project management system and give project team members the ability to upload, download, edit, mark up, and view documents in the folder structure, based on permissions assigned by the Core Collaboration Team.

i. Permissions and Access

The Core Collaboration Team for your project should decide on permissions for the document management file folder structure. In the table below, list the folder or subfolder, intended file content, and permission levels. Examples are shown below.

Folder	Content	Permissions
Drawings	*All project drawings in subfolders*	*Upload: A/E View: Contractor, Owner None: Sub*
Schematic Design	*Schematic drawings*	*Upload: A/E View: Contractor, Owner None: Sub*

ii. Folder Maintenance

Although the file folder structure and permissions should be defined by the Core Collaboration Team, the project system administrator (PSA) is responsible for setting up the structure and maintaining the system.

iii. Folder Notifications

Select groups, individuals, or the entire project team can be notified based on activities in the file folder structure. Notification messages should include information about the file(s) that were updated and who updated them. List the people and groups that should be notified for different activities in various folders in the table below. The first line shows an example.

Folder	Activity	Group to Notify
Drawings	*Upload & Revise*	*Entire Project Team*

iv. File Naming Convention

Earlier in this document (see *Section III-C-i, Model Components File Naming Structure*) you specified the file naming convention for model files for this project. All other files should be accurately and descriptively named. Avoid using the date in the file name, as the collaborative project management system will control the dates and versions. If there are files with special naming requirements, list them in the table below. The first line shows an example.

File Type	Naming Convention
Progress Photos	*Location, hyphen, Authoring Company Initials, hyphen, Description (e.g.: Parking Deck-ABC-Cracking)*

B. Messaging and Communication Protocol

All electronic communication between Core Collaboration Team companies on the project can be created, uploaded, and sent through the collaborative project management system. A copy of all project-related emails sent from outside the collaborative project management system should be uploaded to a folder in the document management file folder structure, or uploaded to the correspondence module. See *Section V-E-v, Construction Management Correspondence* for instructions on formal correspondence.

C. Design Review

The collaborative project management system lets you efficiently manage your design review process, enabling the appropriate parties to efficiently log and update their design review comments, issues, and clash detection reports. Your collaborative project management system should allow users to automatically import raw data from the clash detection software, while design review comments dealing with clashes should include a description of the issue along with visual evidence of the clash. The system will also track the progress and resolution of the design review comments. In the table below, list the model(s) being reviewed, the reviewers, the estimated design review start and completion dates, and how many days the authoring company has to respond to the design review comments. An example has been provided.

Model	Reviewing Companies	Estimated Review Start Date	Estimated Review Completion Date	Days to Respond by Authoring Company
Schematic Design Model	*ABC Owners* *Acme Contractors*	*1/21/2008*	*2/11/2008*	*14 days*

D. Bid Management
For faster, more efficient bids, all bid documentation—including drawings and specifications—can be made available in a Plan Room on the collaborative project management system. The potential bidders can be given access to this Plan Room by the PSA, and will be able to access the documents, download them, or have them printed at a reprographics firm. When there are changes to the plans in the form of addenda, the collaborative project management system will automatically notify all bidders.

E. Construction Management
The collaborative project management system supports your construction management process by managing requests for information (RFIs), submittals, meeting minutes, daily reports, and other modules selected by the Core Collaboration Team. The Core Collaboration Team will also define permission levels and access to the construction management modules.

i. RFIs
RFIs will be created in the collaborative project management system by the [__________] (*specify role*). The RFIs will be issued to the [__________] (*specify role*) for a response, and copied to the [__________] (*specify role*). The primary reviewer will have [__] days to respond to the RFI. The RFI will include all appropriate information that describes the issue along with electronic attachments that may include photos, specifications, and marked-up drawings.

ii. Submittals
Submittals will be organized and electronically submitted through the collaborative project management system. The [__________] (*specify role*) will organize and submit the submittal packages. The packages will be organized by specification section and should be numbered with the following format: [_______________] (*Fill in submittal package numbering format, e.g.: spec section-package number within spec section 09900-01*). The packages will consist of one or more items. The items should be numbered with the following format: [_______________] (*Fill in submittal item numbering format, e.g.: auto-number 001,002)*. The submittal packages will be issued to the [__________] (*specify role*) for a response and copied to the [__________] (*specify role*). The submittal packages will include all appropriate information along with electronic attachments of the submittal items whenever possible. The submittal packages will be issued with an electronic transmittal. The primary reviewer will have [__] days to respond to the submittal package. Each item within the package will receive a response. The possible responses include [________] (*list responses*). All revised submittal items will be resubmitted through a package revision, as opposed to a new package.

iii. Meeting Minutes
Meeting minutes and agendas can be created in the collaborative project management system. The minutes and agendas should include general information such as time, date, and location of meeting, attendance, and discussion details. The discussion details should include information such as issue origination date, responsible

parties, and required completion date. Meeting minutes should be posted to the system no later than [__] business days after completion of the meeting and should be electronically sent to all attendees. The attendees have [__] business days to dispute the content of the minutes, and all disputes must be resolved by the following meeting.

iv. Daily Reports

Daily reports can be entered in the collaborative project management system. The following parties are responsible for creating daily reports: [___________] (*specify role*). The daily reports will include the date, general information, weather conditions, activities, manpower, major equipment used, major material deliveries, safety incidences, and quality control issues. In addition, progress photos and other electronic files should be attached to the daily reports when necessary. Daily reports should be entered into the system no later than [___] day(s) after the day of the report.

v. Correspondence

All formal correspondence between Core Collaboration Team companies should be generated in or scanned and uploaded to the collaborative project management system. Important correspondence received from non-Core Collaboration Team companies can also be scanned and uploaded to the system in the correspondence module.

vi. Other Construction Management Business Processes

Most collaborative project management systems have a number of modules not listed above. List the modules the project team plans to use, including any special instructions and processes, in the table below.

Additional Business Process Modules to Be Used	Special Instructions or Processes

F. Cost Management

The collaborative project management system will facilitate your cost management by managing budgeting, purchasing, the change order process, the payment application process, as well as cost reporting. The Core Collaboration Team for your project will define permission levels and access to the cost management modules.

i. Budgeting

The [___________]'s (*specify role*) budget will entered and tracked in the collaborative project management system. The [___________] (*specify role*) will be responsible for entering and tracking the budget in the system.

ii. Purchasing

The [__________]'s (*specify role*) contracting documents will entered and tracked in the collaborative project management system. The [___________] (*specify role*) will be responsible for entering and tracking the contract documentation in the system. The executed documents may, if needed, be scanned and attached to the contract records.

iii. Change Order Process

Requests for change orders (RCOs) will be created and tracked in the collaboration project management system. RCOs will be created by the [___________] (*specify role*). Each RCO will include all appropriate information that supports the change. Electronic backup can be attached the RCO document. RCOs should be sent to the [___________] (*specify role*) for review. Once an RCO is approved, the [___________] (*specify role*) will issue the [___________] (*specify role*) a formal owner change order (OCO).

iv. Payment Applications

Payment applications can be created in the collaborative project management system. The [___________] (*specify role*) is responsible for creating a payment application in the system based on an approved schedule of values (SOV). A signed copy of the payment application must be submitted to [___________] (*specify role*) and copied to [___________] (*specify role*) by the [___] day of the month.

G. Project Closeout

The collaborative project management System can ease your closeout process. The punch list process will be managed in the system either through the system functionality or by uploading the documentation to the file folder structure. A number of documents will need to be submitted to the owner, such as As-Builts, commissioning documents, warranties, and O&M Manuals. These documents can be uploaded in the file folder structure.

i. As-Built Model

An As-Built model [______] (*fill in: will/will not*) be delivered to the owner at the end of the project by the [____________] (*specify role*). The As-Built model should represent the actual built conditions. The level of detail in the As-Built model will be governed by *Section III-C-iv, Modeling Level of Detail*. List the inclusions or exclusions from the As-Built model content in the table below.

1. As-Built Model Inclusions	2. As-Built Model Exclusions
[List special items that will be included in the model above and beyond the Level of Detail specified in Section III-C-iv]	*List items that will be excluded from the model above and beyond the Level of Detail specified in Section III-C-iv]*

ii. System Archiving

At the end of the project, Core Collaboration Team companies can request an electronic copy of the project documents that were created and stored in the collaborative project management system. This information will be provided by the system owner at the requestor's expense. Each company will have access to the project documents to which they had access while the project was active.

VI. Software Component Selection

To get optimal results from your BIM tools, we recommend using tools that meet the following criteria.

A. Model Creation

The model creation tool should be built on a database platform that allows the creation of parametric and information-rich objects. Parametric modeling dependencies should be automatically updated whenever changes are made. Since the design may come from multiple parties, the BIM tool should accommodate file linking, sharing, or referencing. The BIM technology must be capable of producing 2D plans to fulfill contract document deliverable requirements. The system should be able to create and output files that conform to the IFC (Industry Foundation Classes) file type standards developed by the International Alliance for Interoperability (IAI).

B. Model Integration

The model integrator will be used to combine multiple design files from different software platforms. The tool will also be used for model simulations. The simulation tool must allow the user to simulate construction processes over time and allow for real-time walkthroughs. The model integrator should be able to open and combine at least .dwg, .dwf, .dxf, .sat, .ifc, .dgn, .prp, .prw, .ipt, .iam, and .ipf file types.

C. Clash Detection / Model Mediation

The clash detection tool should be able to perform clash detection analysis on one or multiple design files. The system should be able to generate clash detection reports, which can be exported into either .xls, .csv, or .xml file formats. The clash detection reports should include a list of clashes along with visual evidence.

D. Model Visualization

The model visualization software will be used by project team members who do not need the full functionality of the BIM model creation, integration, or simulation tools. The visualization tool must allow the user to look around, zoom, pan, orbit, examine, and fly through the model.

E. Model Sequencing

The 4D model sequencing tool will be used to visualize the scheduled assembly of the building. The tool should allow the user to visualize the assembly of the building based on scheduling input. It should also integrate with standard scheduling systems such as Microsoft Project or Primavera.

F. Model Quantity Takeoff

The quantity takeoff tool will be used to extract quantities from BIM models for cost-estimating and purchasing purposes. The tool must be able to extract quantities automatically both from 3D and 2D design files. The quantity takeoff software must be able to integrate with estimating programs, or the information from the system must be exportable to an .xls, .csv, or .xml file format. The quantity takeoff tool must be compatible with the model creation tool listed above in *Section VI-A*.

G. Collaborative Project Management

The collaborative project management system may be made up of one or multiple software packages. However, for best results, the complete collaborative project management system should:

- Be web-based or web-enabled—so all relevant, authorized project team members can remotely access it.
- Accommodate different permissions profiles for different project team members.
- Allow communication through either internal messaging or system-generated email.
- Include document management capability that lets the project team create a customized and permission-based folder structure which offers upload, download, and version control capabilities.
- Include a viewer that allows the project team to view .dwg, .dgn, .plt, .dwf, .pdf, .tif, .jpg, .doc, and .xls files.
- Include construction management capabilities for the tracking of requests for information (RFIs), submittals, design review, meeting minutes, daily reports, issues, correspondence, and transmittals.
- Able to interact with the file folder structure in the document management section.
- Able to automatically accept raw data from the clash detection tool.
- Include bid management capability, and this bid management solution should allow the project team to post the contract drawings and specifications for viewing in the form of a Plan Room.

- Allow for cost management controls, and this cost management capability should include budgeting, contracting, change orders processing, and payments applications tracking.
- Allow the project team to run reports based on the information in the system.
- Allow for the workflow and routing throughout the document, construction and cost management components of the solution.

Select the components and specific software you will use and list them below for easy reference.

	Software Component	Model	Software System	Version
	Model Creation	Architectural Design		
	Model Creation	Civil Design		
	Model Creation	Structural Design		
	Model Creation	MEP Design		
	Model Creation	Coordination		
	Model Creation	Construction		
	Model Creation	As-Built		
	Model Integration			
	Model Mediation			
	Model Visualization			
	Model Sequencing			
	Model Quantity Takeoff			
	Collaborative Messaging and Communication			
	Document Management			
	Design Management			
	Bid Management			
	Construction Management			
	Cost Management			
	Facility / Operations Management	As-Built		

VII. System Requirements and Administration

A. Model Creation, Clash Detection, Visualization, Sequencing, Simulation, and Quantity Takeoff Tools

i. IT Requirements

The BIM tools should meet the criteria and perform the functionalities outlined in *Section VI-(A-F), Software Component Selection*. All project team members who use the tool should have the hardware and software to use the system properly; refer to the vendor's system requirements for more details. We recommend running BIM software on Intel Core® 2 Duo 2.40 GHz or equivalent AMD Athlon™ processors, Windows® XP Professional (SP2 or later), 4 GB RAM, 5 GB free disk space, and a dedicated video card with hardware support for OpenGL® spec 1.3 or later.

ii. Funding Source

Acquisition and access to the BIM systems will be funded by [__________] (*specify role*).

iii. Data Ownership

For language or information on electronic information and model ownership, see AIA® C106™-2007 Digital Data Licensing Agreement or ConsensusDOCS™ 200.2 Electronic Communications Protocol Addendum.

iv. Administration

Each party is responsible for the access, licensing and administration of the BIM software systems used.

v. User Requirements

All parties are responsible for obtaining training in the use of the BIM tools. [__________] (*specify role*) is responsible for expenses related to training.

B. Collaborative Project Management

i. System Owner

The [__________] (*specify role*) will provide access to the collaborative project management system. System licenses will be provided to all project team members who need to access the information.

ii. IT Requirements

The collaborative project management system should perform all functionality outlined in *Section VI-G, Software Component Selection, Collaborative Project Management*. All project team members who use the tool should have the hardware and software to use the system properly. Most system operate efficiently on Intel® Pentium® based or equivalent processors, Windows XP Professional (SP2 or later), 256 MB RAM, and a broadband Internet connection. Refer to the vendor's system requirements for more details.

iii. Funding Source

Acquisition and access to the collaborative project management systems will be funded by [__________] (*specify role*).

iv. Data Ownership

Core Collaboration Team companies can request an electronic copy of the project documents that were created and stored in the collaborative project management system at the end of the project at their own cost, as outlined in *Section V-G-ii, System Archiving.* For more language or information on digital data ownership, see AIA® C106™-2007 Digital Data Licensing Agreement or ConsensusDOCS™ 200.2 Electronic Communications Protocol Addendum.

v. Administration

The system owner should designate a Project System Administrator (PSA) to manage the administration of the system. The PSA will be responsible for managing and creating all new user accounts. The PSA will also be responsible for managing the company and contact information in the database.

vi. User Requirements

- High-speed Internet access is required at all locations where the system will be accessed.
- All users should have a unique and valid email address.
- System licenses to use the database will be provided by the system owner for all users who require access.
- Licenses will be granted for current projects only, and in accordance with permission levels defined by the Core Collaboration Team.
- Requests for new user licenses should be submitted to the PSA.
- Company and contact information will be managed in the database by the PSA.
- All parties should submit their company and contact information and revisions to the PSA, and are responsible for ensuring that their information is accurate.
- Each project team member will have their own license and access to the system.

- Licenses should not be shared by two or more persons and passwords should be confidential.
- Users will be prompted to change their password no less than every [___] days.
- All users will log into the system no less than once a week (unless otherwise dictated by project requirements) while the project is ongoing to check for messages and outstanding items.
- All parties should notify the PSA immediately when an employee with access to the system has been terminated, in order to deactivate their user account.
- All parties are responsible for obtaining training in the use of the collaborative project management system.

vii. Security Requirements

The security of the collaboration project management system should include 24/7/365 system monitoring, perimeter security with designated access only, mirror data storage with a secondary facility in a different location, daily backups of the information saved for the life of the project, an Intrusion Detection System (IDS), and at least 128 bit Secure Socket Layer (SSL) technology.

VIII. Appendix

A. Definitions of Terms Used in this Document

As-Built Model - The final model that shows how a building was actually delivered and assembled. This is also sometimes referred to as the Record model.

Building Information Modeling (BIM) - An integrated process aimed at providing coordinated, reliable information about a building project throughout different project phases—from design through construction and into operations. BIM gives architects, engineers, builders, and owners a clear overall vision of the project—to help them make better decisions faster, improve the quality, and increase the profitability of the project.

Clash Detection - The process of checking for clashes and interferences in the design of one or more BIM models. It is also referred to as model mediation.

Collaborative Project Management - A software solution that enables effective management of and collaboration on all project-related communication, information, and business processes across the plan, build, and operate phases of the building lifecycle. The most common processes include collaborative documentation, design, bid, construction, cost, and operations management.

Construction Model - The model used to simulate and analyze the construction of a building.

Coordination Model - A model created from two or more models, used to show the relationship of multiple building disciplines, such as architectural, civil, structural, and MEP (mechanical, electrical, and plumbing).

Core Collaboration Team - The group of people—which should include someone from each party working on the project, such as the owner, architect, contractor, sub-consultants, suppliers, and trade contractors—that is responsible for completing this BIM Communication Specification, creating the document management file folder structure and permission levels in the collaborative project management system, and enforcing the action plan set out in this document throughout the design and construction of the project.

Design Intent Model - The model used to communicate the design intent of a building.

Industry Foundation Classes (IFC) - A neutral and open file format structure developed by the International Alliance for Interoperability (IAI) to enable interoperability between modeling software systems.

Integrated Project Delivery (IPD) - A project delivery process that integrates people, systems, business structures and practices to collaboratively harness the talents and insights of all participants to optimize project results, increase value to the owner, reduce waste, and maximize efficiency throughout all phases of design, fabrication, and construction (AIA, *Integrated Project Delivery: A Guide*, 2007, available at www.aia.org/ipdg).

Model Integrator - A tool used to combine and/or link multiple design files from different software platforms.

Model Manager - The project team member(s) responsible for managing the collaboration and sharing of electronic files during the project. Model managers are also responsible for maintaining the integrity of the BIM models, which can include gathering, linking, and uploading updated models.

Parametric - The relationship among and between all elements of a model that enable coordination and change management. These relationships are created either automatically by the software or manually by the user as they work.

Project System Administrator (PSA) - The person who manages the administration of and folder set-up in the collaborative project management system, and is responsible for managing and creating new user accounts as well as the contact and company information in the system.

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