

Facilitator

Yeah, let's just start it. If there are more people.

Researcher

OK.

Facilitator

As I said we really value your time.

It's an interactive workshop and it's more on the quantitative nature of giving feedback on the framework [Researcher name] has developed.

Even one person is not about the having too many people in the workshop. So I think it's very viable anyhow.

Researcher

OK.

Hello Everyone.

Thank you so much for joining this Co creation workshop, which is part of my PhD that focuses on designing and developing solar cooling integrated facade.

So just a quick background who we are.

I am part of this architectural facade and products research group.

I've been working with this group with this group for the last four years. As you can see from this slide, this group has different research themes and we have key leaders in charge of every theme. For example, Ulrich Knaack, who is one of my promoters. He is in charge of the multifunctional smart facades and my other promoter, who's here, Thaleia Konstantinou. She is taking the lead in refurbishment strategies, and there are other two people focusing on circularity and human-centred design.

So I about my PhD. As I mentioned that Thaleia, who is the Section Leader of Building Design and Technology in our department. Ulrich Knaack is a professor of design of construction, and we have Alejandro Prieto, who's an associate professor at Diego Portales University.

So know let's have a quick round of introduction.

So I am going to let you to introduce yourself; your background, which team you belong to (design team or construction team).

So maybe I can start with [Name of participant 1].

Participant 1 (Design Team)

Yes, thank you.

My name is [Name of participant 1] and I work for [Name of Dutch Engineering and Consultancy Firm] in [Name of a Dutch city].

I'm a senior consultant in the in the facade and building technology team.

Maybe it's good to tell why I'm interested in this subject.

It has to do with my previous job. I just used to be the manager of the R&D Department of [Name of a consortium of companies specializing in the design, engineering, production, and installation of windows, walls, and load-bearing structures made from aluminium and steel].

And [Name of a consortium of companies specializing in the design, engineering, production, and installation of windows, walls, and load-bearing structures made from aluminium and steel] was a huge facade constructor.

And around....I think it was 2002, 2003....We did an investigation into the possibility to integrate thermal solar systems in the building.

We saw that in Germany and Switzerland there were some solar thermal projects in that in those countries. But we wanted to use the heat not for hot tap water....but we wanted to use the energy for cooling the buildings, especially for office buildings.

Yeah, I that was a very interesting survey. At that time 20 years ago, we saw that it could be feasible for a lot of different strategies. Although there were no building products available to build those things....that development had never took place.

Facilitator

OK.

[Name of participant 1] that's very interesting.

Thanks for this information. That's exactly what we try to do here, because we also see the potential. Also the work of Alejandro who is now in the supervision team was on that. And really want to see how can we bring this further in terms of implementation so that's a very good match.

Thanks a lot.

Researcher

Thank you so much.

Now we can move to [Name of participant 2]

Participant 2 (Construction Team)

Hi

Thank you so much for inviting me.

I'm [Name of participant 2].

I'm an Building Engineer.

I also have a PhD that really focused on developing active façades.

In fact, during my PhD, we developed a little prototype of thermoelectric façades with really interesting results.

And then I move to [company name], that is a construction Spanish company.

And I'm now the head of R&D projects. And of course, now I move a little bit from really focusing on façade during my PhD and my period at the university....and now I'm more focus on prefabrication and industrialized solutions and trying to really integrate this type of research and ideas in a real site....that sometimes is tricky.

So my main role here in the company is trying to bridge between universities and this new ideas into the real world of the construction sites, that sometimes is tricky.

So challenging, but I think that we have a lot of things to say to this investigations, you know that you be more realistic and more....Yeah, realistic maybe is there word there.

Researcher

Ok, Nice.

So last but not least, [Name of participant 3].

Participant 3 (Design Team)

I guess you can hear me now, yes.

Researcher

Yes .

Participant 3 (Design Team)

Nice. Thank you.

So, well, as you see my name is [Name of participant 3].

Currently working in one of the biggest design studios in Spain. It is called [company name].

It's kind of hard for other languages to mention it, but it's like really typical Catalan names from here.

So nowadays I'm leading the sustainability department of the company and basically we face different challenges in the company in three different scales.

One is urban planning....the other one is landscape....and the other one is buildings.

And also a bit of my background...I am a architect...I did my studies in architecture.....but I always switch in innovation and construction at the same time.

I cross paths with [Name of participant 2] in some European projects, and the [name of specific project]....developing a new facade system.

But now I'm more focused on the designing part.

Researcher

Ok, Thank you.

Facilitator

Thank you.

So maybe to recap a little bit

So if you see the team that you belong to...Could we say that maybe [Name of participant 3] and [Name of participant 1] are more on the design team and [Name of participant 1] would be more in the construction team...Would it be?

Participant 1 (Design Team)

Yes, I'm OK with that.

Facilitator

And I mean the client would don't have any client here. But of course we can always try to bring the client perspective based on your experience.

Researcher

OK.....So why we are?

So as we have some designers....construction team....We need to think and plan together.

We need to identify, map key decisions, determine which information that we need to process decisions, and we need to determine which roles of people....or who is involved in making these decisions...and then we are going to reflect together about this whole framework for designing and developing solar cooling integrate facades.

So now, as I said, in the interactive session, we will focus on identifying decisions, organizing the decisions and then determining required information to process decisions, and then stakeholders involved in making the decisions.

So now I'll just give a quick background about my research before we go to the interactive session.

So...Actually, we are on time.

Now it's 9:15....So I should stop in 10 minutes the background about my research.

So solar cooling technologies and building facades....One of the main things that I paid my attention about integrating solar cooling technologies into building facades is the current challenges with the climate change....We have the climate change.....We have the population and economic growth and we have the building facades that are exposed to solar radiation.....and for this we can think about why don't we harvest this energy to derive cooling equipment using renewable sources of energy.

Now.....As all of you are experts on different types of technologies and solar technologies in general.....It is an ongoing development and there are different forms of technologies. But for the sake of my research....This, just for the sake of my framework we are focusing on thermally driven technologies.....We are talking about flat plate collectors or evacuated tube collectors.....Or electrically driven technologies.....focusing about PV panels integrated with vapor compression chillers, or thermoelectric processes.

Now how we can define solar cooling integrated facades... I've been into the literature....Different experts that have defined solar active envelope facades, solar cooling, integrated facades.....And

some of them, they had some practical.....Some of them, they had some restricted definition where you integrate all elements in a facade unit, which sometimes could be not workable for all technologies because some technologies you have different components.....So we came up with this definition..... “Building envelope systems that include elements using and or controlling solar radiation to deliver self-sufficient renewable electric and/or thermal energy needed to generate cooling effect in a particular indoor environment”.

Now the question to our mind.....Like, OK, why such facade integration not commonly applied?

This is due to the fact we have some different forms of bottlenecks that require us to consider and integrate various aspects, technical and product related, some financial aspects, as well as process and stakeholder related aspects.

So the last few years, I've been working on identifying how we can bring this potential to the market. So I've conducted qualitative interviews with various experts like you two years ago to map what are the key enablers within facade design and construction stages...And as you can see, for example, one of the key factors is to facilitate the delivery of product information to stakeholders and this is part what we are going to do now. We are going to organize decisions, information and stakeholders involved in making decisions.

Also, I've been exploring which potentials in terms of building topology as well as project type. So many people perceived that integrating these technologies into office buildings, as [[Name of participant 1] said, was one of the most relevant sectors to tackle.

Also in terms of project type, new construction, because when whenever you design new buildings, you have more design freedom to integrate these new technologies.

My framework....Now that I've been working on...focuses on 5 design stages.....The first one is to identify building envelope possibilities. Then we assess the feasibility of generated possibilities. Then, based on this assessment, the technology is selected. Then the detail design and then the executive design, which is the final stage which is where we focus on how to install the components.

So in the interactive session, we'll focus on these five stages.

So just to recap, considering the previous five stages, we are focusing now in the interactive session....We will focus on identifying key design decisions, organizing the decisions, determining required information to process decisions, and identify stakeholders involved in making the decisions.

So to do that, let's have a sort of an interactive session.....Let's assume that we have this type of building. It's an office building.

We have two people from Spain.....Let's assume that's going to be located in Madrid.

It's mainly office spaces, but it has some zones where you have, dining rooms or toilets or store rooms.

So mainly we have curtain walls for most of the orientations....Except....Let's assume that the South part is an opaque part....Because most building services and rooms are on the backside of the building.

These are some of the construction characteristics of the materials to be used with reinforced concrete, double glazing facades, yeah.

And let's assume that this is some information about the building energy performance in terms of annual energy use intensity, annual cooling demand, average daily cooling demand in summer design week. All of this information is going to be provided on the Whiteboard, where we are going to see it in a minute.

Let's assume that the client of this building is a private company and it's a single client and the client is the same as the user who going to use this.

And this client is looking to investigate which technology to be integrated. That client is thinking about....OK, we need to end up with a facade solution that could be either electrically driven technology or thermally driven technology. So he's imagining to end up with such detailed design either we integrate solar thermal collectors to generate cooling effect using absorption chillers, or we go with electrically driven where we consider the PV panels to derive cooling equipment, vapor compression chillers.

So we if we think about this client and this is this office building.....We need now to go to the whiteboard to think about, what are the key decisions to be taken and we need to prioritize them, determine required information and identify stakeholders involved in making these decisions.

So before we go to the Whiteboard...Just to let you know.....So there are actually three main parts actually....It seems 4, but it's actually 3 because we are going to focus on the yellow part or the yellow sticky notes.....We are going to write the decisions then we are going to organize the decisions together. Then we need to determine what are the required information to process these decisions and which stakeholders involved in making these decisions.

So now I think I'm going to stop sharing my screen. Then I'm going to share the whiteboard and we can check together how the setup work.

Facilitator

So the Whiteboard is a little bit like Miro, but because it's through Teams, you would be able to work on it directly here.

So let's just once [Name of researcher] shares it, then we go through all the steps to make sure that you also can zoom in and zoom out, because we'd also like you to feel free to make notes on it and so on.

Researcher

So [Name of participant 1]....I see all the names.

Participant 1 (Design Team)

How can I start?

Researcher

Yeah, you can zoom, but let's say that if you see my mouse.

So the information that I have provided about the project are provided here.

Participant 1 (Design Team)

Yeah.

Researcher

The exact information that I mentioned about the projects are here. So the client would like to end up with a facade solution that could be either electrically driven or thermally driven. So we'll start with this box. Can you see my mouse?.....the yellow box?

Facilitator

So just be aware that you can zoom in for yourself. So like what you see in your own screen is not what everybody sees.

Researcher

Yes.

Facilitator

You can zoom in and out for yourself.

Researcher

You exactly as [Name of facilitator] said.

You can zoom in and zoom out.

You can now zoom in and this yellow box. You can see that it has a sort of a group of sticky notes. Can you see it?

So now currently what we are going to focus on as, I said, we need you now to write what key design decisions to be taken.

So these are examples of decisions. Generally you can rephrase them or you can elaborate more about these decisions.

And then we are going to now give maybe 10 to 15 minutes to everyone write decisions.

Facilitator

Let's just go through all the steps so that we are a little bit aware of the bigger landscape of this exercise and then we're going to, as [Name of researcher], focus on in a minute.

So the first step is around this yellow, yellow postage, which is the key decision. And here, as [Name of researcher], said already, we have some example, but we would like to go a little bit deeper into that and then the idea is to organise those decisions that we made along the stages. So I'm moving towards the right, on the screens, on the green part. When you see all the stages. Maybe you also see where my mouse is. So, we will try in a way to take the postage and see how they are organized along the stages.

I can very much expect that some of the decisions are repeated in different stages, maybe in another depth or detail. So we can elaborate a little bit on that. And once we have a little bit of a mapping of the type of decision, we want to go and see....So and then....Now we go a little bit lower on the purple part. We're going to go and see what information do we need to process these decisions....Make it, evaluate it, assess the feasibility and so on, and also at the same time along that we could also try to identify the stakeholder. So here we said we are representing a bit more design and construction team. Like me and [Name of researcher] we can again be a little bit more

on the design side because we're working with the design of a façade. But then we are also interacting with the designer with clients and contractors.....

So let's try to think along to identify also who can be the main responsible, who can be participating in this decision and providing those information. So that's the whole process. We have accounted more or less an hour to do that. I think it's quite comfortable. And we will guide through, but we're a small group, so feel free to just say whatever you think is relevant. So let's go now all together at the yellow part, the key decisions. And I would also like to highlight that the end goal of this exercise is not to come up....Oh [Name of Participant 4] joined. Great.

So just before I go on introduced it quickly for [Name of Participant 4] as well.

Participant 1 (Design Team)

Yeah.

Facilitator

Hi, [Name of Participant 4].

And maybe he can follow along.

Participant 4 (Design Team)

Hello.

Facilitator

Hey. Hello.

Thanks for joining us.

You missed the introduction, but we are already in the interactive session, so I hope you will be able to catch up. So hopefully you see in the screen this Whiteboard that you are able to do things directly on the shared screen because it is integrated in Teams.

So now we are discussing the key decisions that are being taken during a design and construction and evaluation and so on. And the idea here is not to conclude with the full on design in the framework of this exercise, but to really make a connection between what decisions and what information we need, and who takes it. Looking a little bit more in the product development process. So of course eventually we'll.....We made this case only for reference, but if you have examples that apply or if you get inspired by some of your own experience or cases, feel free to bring it along.

OK, so if we all focus a little bit on the yellow part. Here we mentioned some things about the connections, relevant measures.....So those are not yet in a kind of a sequence, but I think we can just take a moment to write whatever you think might be relevant.

So it's not a sequence....We can talk about the level of detail, so whatever you think is relevant. For example, here we say identify the location for component. I would maybe try to add on that and say "Check how much space the facade has or check how much space....what is the area available on the roof....or check the window to wall ratio". So whatever you think, could be relevant to this or other thing that you think.....Let's just all take 5 minutes on our own to think. And please right there. As I said, there's no wrong answer. We can discuss a bit altogether to make it more detail or explain what it means. Is it clear for everyone? Shall we take those 5 minutes?

Participant 1 (Design Team)

I was wondering what you mean with determined means of connections.

What kind of connections are you looking for?

Facilitator

Yeah, I think this could be.....As I said, like feel free to elaborate whatever you think is relevant, but in my head this is the connection of the facade to the structure, but also like the connection of the water and where are the storage....So it could be both.

Participant 1 (Design Team)

OK, the physical connections between the components.

Facilitator

The physical connections.....yes, yes.

Let's just try few things.....As I said, whatever you think is relevant and then we can elaborate a bit more.

Researcher

[Name of participant 4] can you see the canvas.

Participant 4 (Design Team)

Yeah, I can, but I've never worked with. So I was wondering actually is it a Miro Board or not?

But it is actually this is it's part of....

Researcher

Teams

Participant 4 (Design Team)

Teams....Yeah, I'm just exploring a bit how it works, OK.

But I can work on it and I can see it.

Researcher

Yeah, it's the Microsoft package. It is like the Miro but the Microsoft type of Miro, you know.

Participant 4 (Design Team)

Yeah, yeah, it's fine.

I didn't know it's kind of....So I can do things here.

It's yeah. OK, super.

Researcher

By the way....everyone just.....actually you can copy a sticky note.....For example, you can copy a sticky note I think.....See.....Yeah, you can. When you click.....Control C and you put it and you take your mouse....Control V then your copy actually.

Facilitator

Ok....So we're getting few.

Is everybody almost done?

Do you have some more ideas you would like add?

Participant 3 (Design Team)

Done from my side.

Facilitator

Thanks a lot.

So let's see a little bit what we have.

I would like to invite. You can also, as I said, you can zoom in and out for yourself. What I see in my screen is not the same what you see.

So let's look at the type of decision that we have. So we see here at the top that there are some things a little bit more practical like access to maintenance, maintenance requirement, ease of installation....Life expectancy...I think this also relates to maintenance and also a little bit overall how long it will be....Weather resistance....So there are a little bit more practical....Which I see even being important in different stages, but we can comment very soon.....Because I think it's also something to start thinking about. It should even do that, but then also if we see the potential and feasibility part, then we do need to provide this information. So I see these are being in more than one stage.

Then we have something that relate to the demand....so designing the building with the aim of reducing energy demand.

We also see some of those, if will go to a little bit lower like passive measures, but cooling demand is high, focus on design strategies on reducing cooling demand. I think this relates to how can we combine the system with passive measures....or in general about the demand, how much is the demand....and then this relates with the part about optimizing design.

Then we have something about the system, like what components are there....storage, evaporation.....Also the type of technology.....But then also some practical things like the size, the weight, the fire safety. So which I think these are important and we can discuss it in a moment. But for me, and I would really like your feedback on that....because I see those coming back in several places in the discussion and also to make the decision to go for such a system and then to really be able to solve it.

There are also some things about the building typology or the architectural elements....are there...The daylight, orientation...So the combination with the actual facade design.

Yes, so.....If we go like now with that in mind.....If we go a bit towards the green part and then I also copied a little bit higher on the on the top right part....I copied the slides of [Name of researcher] with all the stages....As a frame of reference. So here I think it's good to have another view of the stages and then start putting slides to each one.

First of all, maybe before we even go to the stages, let's see if you have some additional comments about this kind of decisions. Are there some that are more relevant to your practice?

Are there some of those discussion that you see them coming up more prominent and a little bit of make or break situation?

Participant 3 (Design Team)

Here what I can say [Name of facilitator] in this regards.....At least from our side as designers....So we are trying to push a lot our design for new buildings, especially to be more sustainable now. So since the very beginning, we'd say preliminary design. We're trying to identify first or simulate first the building in terms of volume to identify the demand, the energy demand in terms of cooling and heating. But then, once we have this, we are focusing other strategies for the energy consumption. So identifying the heating and cooling consumption, lighting and water in this case. So for this instance, when we identify the energy consumption and we are trying to push our buildings to be self-sufficient, we are identifying strategies to implement in the building. So when we have enough room to implement PV panels and to be self-sufficient, for example, maybe we not focusing on the facade aspect. But when the facade aspect has potential to include more energy production or whatever, it's when we're starting introducing this. So it's really related on the building form or building typology.

Facilitator

So I think it's maybe you also wrote this building typology.

Participant 3 (Design Team)

Yeah.

Facilitator

So I think this is something that you would you would prioritize and....OK.....That's very good to know. And so that's in a very concept phase discussion. I think it's not when you are really.....maybe you don't even have the whole architectural form yet.

Participant 3 (Design Team)

No, exactly. But we identified these different factors that could affect a lot on the building....and then we focus on which ones we can mitigate. So for example, high rise buildings.....The fact is clear they don't have enough roof to make energy production. So if we include this in the facade, usually PV panels has less energy performance. We're trying to look for different innovative solutions.....or to mitigate the cooling and heating demand through passive systems.

Facilitator

Yes, of course.....Because of course we all know like passive design has its limit especially in high rise and so on.....But it is not like it's not competing in a way. It's not like we do solar cooling or we do PV, so we're not going to do so. It's going to be both. So they I think like the passive design of the buildings is not necessarily part of the solar cooling product development. It's something that goes along, but I think it's good that we bring it here because we could also maybe see possibility for integration. For example you have shading devices. Maybe you can also generate energy or the hot water and so on. But that's also good to keep in mind.

Anyone else wants to go to highlight what of those type of decisions would be important for you or maybe a key point to start the discussion for solar cooling?

Participant 2 (Construction Team)

I would say that maybe as a construction company, we should take into account from the very beginning how we're going to install these things. In terms not only about cost, but also about auxiliary elements....if we are going to need really a specific labour there. I mean nowadays that we have a problem in entire Europe about.

Facilitator

Resources?

Participant 2 (Construction Team)

Yeah. So I would say that maybe from the very beginning, we can think about a prefabrication solution, a plug and play solutions in terms to try to reduce time on site and to try to make things better. But of course I think that this is something that we should take into account from the very beginning of the design of the solution, because if not is going to be impossible.

And I think that this change a little bit all the perception of the concept that we are thinking about....A prefabrication solution of the facade, the entire façade, is one thing and then the other is just trying to install things in the building. So I think that the design completely changed and the way you are thinking about the solution changed completely. So it's something that you should decide from the very beginning. For me, that's it should be a plug and play solution in order to improve the performance of the of the active part, but also then you are going to ensure that the passive performance is going to be also better.

Facilitator

Yeah, yeah.

Participant 2 (Construction Team)

So I think it should be a decision to make at the very beginning of the of the process.

Facilitator

So, particularly for the installation?

Participant 2 (Construction Team)

Yeah, yeah, yeah.

Facilitator

Again you wrote "easy to install without failure".

Participant 2 (Construction Team)

Yeah, yeah, I am the one.

But yeah, I think we should take these things into account because when....

Facilitator

Yeah.

Participant 2 (Construction Team)

Sorry, sorry go [Name of facilitator]

Facilitator

No, no....I'm just thinking of what you are saying, because I think that's very important....on this this prefabrication aspect....I mean of course, like when you said fabrication, are you thinking more of a kind of unitized facade?

Participant 2 (Construction Team)

Yeah, I am thinking about modules.....Trying to make things bigger from slab to slab and trying to include all the things there, the insulation, the active system, everything there and try to make this off site and then everything is easier on site.

But of course this is something that you can't think once you have this designed building, but something that you have to think in advance.

So because if everything changed, change the design, changes the production of the element....This is something that everyone has to think about it from the beginning.

Participant 1 (Design Team)

I fully agree with that.

My experience of two decades in the construction industry.

If the contractors are not happy with the solution, it will never be a success.

Participant 2 (Construction Team)

Sure.

Agree

Facilitator

Yeah. OK.....and I think in this sense, this alliance also with what [Name of participant 1] said at the beginning, that there were no available products. And I think we should think....I mean that's the way I approach it, a bit like the unitised facade is a product.....what we're discussing here is a product development for unitized façade....It is not only for the solar cooling because it's about the integration....I think we can also keep that in mind in this discussion....what do we need for the product development which is also of course the focus of [Name of researcher].

Participant 1 (Design Team)

And that is also a critical factor for the for the client, because a client that doesn't want to do an experiment with a Millions investment he wants. He or she wants a building which lasts for at least 50 years or even longer. They don't an experiment.

Facilitator

Yeah, that's the life expectancy point that we made.

OK, so with these comments in mind that were I think a very relevant and also resonated a lot with us. Do you see those stages? Again, if you think of the development of a unitised facade or

modular facade that integrates this technology, we can see a little bit as a product development, but of course also part of the design process. But here we want to focus on the decisions related to the solar cooling, of course, it's not a hard line between design decisions and that, but for the sake of this exercise.....Do you see still these stages being relevant?

So we have talked about the stages. So we have the first stage about identifying possibilities, which about it possible to do it? What are the requirements. Maybe some basic maintenance issues or other practical issues. Also what [Name of participant 3] said. Shall we look at that or is that enough to put PV on the roof. So I see this a little bit more kind of general.....But then I also go in stage B.....go one step further to assess that....Because maybe it's not enough to say, maybe we need some numbers about it....It is going to be rough, but we need somehow to assess it.....So between A and B, we need to decide that this is really something go ahead. I think we can here start with the provision that we are trying to integrate solar cooling, but we also need to be critical in what you mentioned that people need to have some kind of guarantee that this can happen and it's going to work.

And then we go in stages C and D and of course E into more detail into designing the system and then going to the details about it, and of course then the installation. Do you see the stages associated with the process that in your experience?

Participant 1 (Design Team)

Yeah, if you want to design a building, it is in logical sequence I think. But if you want to design a product. It might not be the right sequence. I'm wondering what you are looking for....Are you looking for a building process or a product development process?

Facilitator

Yeah, that's a good question.

I mean, I think it's not a product in the sense that you have an air conditioning unit that's a product that you install the same thing everywhere. When you develop a modular system, it needs to be adjusted to the building, but the product design as opposed to the to the building design as I see it, is that....It's you design products for buildings and then you need to have some standards. So a lot in the building design where we start the process from scratch.....But when we're talking about prefabricated component, we have some basics. We have some basic system that we adjust to the building. So in this sense...I in my view, I think the solar cooling is more of a product design rather than a building design, but I don't know....I would also like to hear your opinion about it. How should we approach this? What is more relevant, if you see the in house happen in practice, but how do you think it can improve?

Participant 1 (Design Team)

Yeah, I think there are processes in parallel. If you design a building, you work from big to small. You start with the volumes and the shading and.....If the building is in between other buildings, you can't forget the solar cooling, of course, on the facade. So that's the first step....And then you look at the possibilities and then you can choose between different products. For example, that modular system. Because it's hard to develop a product for one building, from commercial point of view....and it the product, the solar cooling system, the modular solar cooling system.....should be available for more different kinds of buildings I think. Otherwise, it will never be successful.

Facilitator

Yeah. And then [Name of participant 2] in your case, how do you approach this prefabrication?

Do you start thinking of a system every time from scratch based on the existing building? Do you have some standard system that you adjust?

Participant 2 (Construction Team)

Depends on the client. I mean....completely.

We are only a construction company, so the clients arrive with a project.....usually with a draft design of the building.....what he wants to do or she wants to do, and then.....

Nowadays, at least in Spain, the construction companies is the one, at least my company, is the one who propose to change the design into a prefabrication solution.

So if the clients agree, we have to redesign completely the building because the prefabrication system, industrialized solutions, works completely different from a conventional design.

So probably you have to change a lot of things. I think it's even harder if you have active systems in the façade, so it's a tricky thing.

For us as a construction company, we try to be in the process, as soon as possible in order to avoid all these reworks. So from the very beginning, the client wants an industrialized solution, so it's something that is better, everything is optimized and so on. And you start from the scratch and you start like thinking that this is an industrialized solution.

Of course, nowadays it's expensive than the conventional solution. So you have to balance a lot of things there. The direct cost of the solution, but also that you are saving money in the indirect cost because the works on-site are shorter, so there are a lot of things to analyse there....the carbon footprint of the solutions, the.

Of course, I think that when we are thinking about this type of active solutions, we think about a really specific building, maybe the cost there are not the most important thing because they are really thinking about energy saving and they want to improve this type of things....So I think that it depends on the client.....that depends on the objectives of the client with the building.

But I think that nowadays we should go to prefabricated solutions...You need thing that include everything, at least this is my perspective.

Facilitator

Yeah. I am also very much associated with this....OK also looking a little bit at the time....So what I would propose like, but I think....This is a very in light for me this discussion

I would say, let's just follow this process as what we have identified here, which is more towards a design development of a building....and maybe we can reflect at the end to what extent is the product development. For now let's just follow that. So I was thinking that we could also altogether discuss posted by posted and put it somewhere, but I think based on the discussion we're having, maybe it would be good if we all take a moment, to put it along the stages as we perceive them, and then discuss it. I would suggest that we do this with a yellow postage, and then just copy so we still keep the yellow overview, but we also copy them....[Name of participant 2] you have the question?

Participant 2 (Construction Team)

No, no, sorry I tried to move my screen and I.....

Facilitator

Fine, exactly.....So for example, also, as you talked, I made the comment about modular and industrialized solution. So that's something I will copy, for example here at the beginning of the identify possibilities, because it is starting to identify possibilities, but also the building technology as [Name of participant 3] said, I will also copy it here.

So let us just take few moments for that....As I said try to copy....if not, don't worry we can make it together....whatever is convenient.....So let's do this for few minutes. So everybody for themselves try to go along all the phases, because we also tend to do more in the first phase in these discussions.

And you don't have to look at what the other people have done, because if it's the same postage repeated then it means that more people support that this is something that goes there.

Researcher

Alright, I'm going to extend the boxes, so if we might need some spaces I think.

Facilitator

Yes, if we need more space downwards, it's fine. But it can be a little bit messy....We can sort it out.

Researcher

Yeah

Facilitator

Yeah, I also tend to put posts together that I think kind of belong in the same type of decision or their linked as decision. For example, the modularity but then how is it going to be installed, sizes....I think it's something that could be part of the same discussion....but yes, let's talk about in a moment.

It is interesting because so far I see that we are less concerned with the actual performance and more about if it's possible to do it in terms of construction or maybe we prioritise this and then we will worry about the performance.

.....

And [Name of researcher] you can also keep a little bit in check that we have used most of those decisions along the stages.

Researcher

Yeah

Facilitator

Yeah, I seen the last one we have less....and I wonder if this is because we think it's not necessarily a problem how it's going to be installed, especially if we have a modular solution already decided for.

.....
Ok are we more or less done with transferring the decisions?
.....

OK. So let's look a little bit in detail. Let's go stage by stage.

So if we look at the first one, identify possibilities for building envelope. So we see about preliminary energy consumption, the actual design of the building and the energy demand, size and weight and whether it is a modular system and if it can be integrated.....analyse installation process: auxiliary elements, conflicts with other activities....I feel this might be a little detailed, but I think it also aligns with what [Name of participant 2] was saying that we have to know that this is possible to decide for. So I think to really go to if there are other elements and conflicts.....I think that's something you try to solve more in the last phase, but I think that it's good to highlight here that it's important on the feasibility side before we decide.....And then of course we have the building technology orientation, architectural element that's also what [Name of participant 3] was talking about....And then the life expectancy (How long does?).....Because we already said that nobody wants an experiment on their buildings.....There's a project who paid for that....A research project.

And then going a little bit further, like in stage B, we see here.....as I see this is mostly about identifying that it makes sense also in terms of demand and cost. So really how feasible this is. And I think when we go adding information here is where we actually want some data about it. That's how I see it, and also I think this is more or less reflected in what we say here and we see the weight of the components coming back. So I think like the level of detail we might be looking potentially changes because of course it needs to be feasible that things are not too heavy or I mean of course we can accommodate anyway, but if this means making the structure much bigger, this will be extra cost. I think this is part indeed of the feasibility.....And I would also expect that here we want some information or at least some basic information to see that we don't grow.....at least the order of magnitude of this weight and.....And then it's about the facade technology.....I think here is we mentioned things like the orientation, the components, how this going to be maintained.

[Name of researcher] here when we say architectural facade technology is this, for example, whether it's a modular system would be here?

Researcher

It could be yes, but it's mainly like the technology that is going to be architecturally integrated to the facades. It focuses on the technology that is going to be integrated within an architectural facade solution.

Facilitator

So whether it's thermally driven, for example or electrically driven.

Researcher

Yes, yes.

Facilitator

So it's more on the solar cooling technology.

Researcher

Yes, yes.

Facilitator

OK.

Researcher

That's going to be integrated architecturally into the facade element.

Facilitator

Yeah, then I think the posts there are very well with this.....And then it's about the detailed design which is very linked to the previous point we made.

So maybe it's worth discussing if those two stages need to be separate and also if we need different type of information between the stages and then we have the installation.....

I mean here we say design for installation but this really how this can happen, so going beyond the detailing....An here it's it comes back like the auxiliary element that conflicts.....and to guarantee....how the maintenance is going to happen.....modular and industrialization....we decided for that, but this is here where we do it, so we design also for this modularity.....How are we going to maintain it, cost.....Is this something?....I guess this relates with the other point about guarantee.....So I put those together.....I think it's the same thing like we have decided that it's possible and then we really have to design and install it that it is possible.

Okay.

So how does everybody feel about this distribution of decisions?

Do you have any comment?

Is this something that you can associate with?

Participant 3 (Design Team)

I would say just one thing....Really short.....For us as designers, we have a different speech as the owners.....and also different speeches as the constructors....And one of the main things that usually come up to as designers, is the cost of the system.....which will be the amortization for the for the client side.

Facilitator

Yeah, you mentioned here, yes.

Participant 3 (Design Team)

Exactly. So for us, it's always hard or we have to do a lot of effort to justify this kind of strategies on the project....Because for them usually what they see in a façade is Euros per square meter instead of something else.

Facilitator

So amortization, you mean like the payback or other benefits?

Participant 3 (Design Team)

Yeah.

Facilitator

And is this something now.....I guess you placed it at the very beginning where we have to identify the possibilities and maybe give it a go and so on.

Participant 3 (Design Team)

Yeah.

Facilitator

I think it's there and then it comes back where we are talking about finding the balance between the cost and the benefits. In the second phase, so I guess it would be both, right?

Participant 3 (Design Team)

It would be both, but it's really important at the beginning to.....I mean, if they see potential on including innovative systems on the façade or energy production or whatever, they would be probably more happy to include them in the project. So if not, you have to discard them really beginning to say no.

Facilitator

OK, which is a nice bridge I think to get us to the next stage of this exercise. So if we look a little bit at the purple information decision. So if we look, we have there some regulations, characteristics of the envelope, sizes, weight and so on, cost of the technology....So if you think of this point, cost versus payback which we see it needs to be at the beginning because otherwise it's a no go....Which information are necessary.

So you if you can go down.

Researcher

To the purple. Yeah, yeah.

Can you go down to the information to process decisions?

Facilitator

Yes, I see [Name of participant 3] and [Name of participant 2]

Researcher

[Name of participant 1] could you go down to the information to process decisions?

Facilitator

So yeah that you can look at them.

Researcher

We just go down to the purple part. I don't see [Name of participant 1].

Participant 1 (Design Team)

I'm here.

Facilitator

Are you able to see the information that we have identified? And of course feel free to add more.

So what of those information you think are important to have this discussion.....with the client and get the go? What would they need to know?

Participant 3 (Design Team)

Usually.....I mean following a bit what [Name of participant 2] said, we always see that there are two kinds of clients. One is the investor who's going to sell the building and the other is the owner.

When the owner is the one who's going to keep on the building, they usually are more happy to invest in innovative solutions because they know that it's going to be a payback behind.... and when it's an investor there....No....There is a price per square meter that they want to achieve and there is no chance to do anything else.

Researcher

And when the case of the owner is the same as the investor?

Facilitator

Then you have more possibilities, right?

Participant 2 (Construction Team)

Yeah, for sure.

Participant 3 (Design Team)

Exactly. Yeah, exactly.

Participant 2 (Construction Team)

Without any doubt.

Participant 3 (Design Team)

So that they are willing....exactly.....To...I don't know....To install systems that are producing more energy and then you can make a life cycle cost analysis and see which is the payback, considering also maintenance and the energy production that you are having on the building....And then all these elements for them are necessary to include them in the first decision of the project. So it's not something that should come later on, it's something that we are trying to introduce in the very beginning.

Facilitator

So thinking a little bit at the same time.....because like this information and decisions.....We will try to think them a little bit at the same time as the stakeholders. So I think a lot of the things at the beginning it's about this....Like financially, does it make sense? And it's very important to say like the client wants to try this technology.....They want to have a modular system. They want to have an innovative technology for cooling because it will save them in the long run....So I would

like then to really copy the owner as a stakeholder here, on this cost versus amortization. Of course the owner is the one making a lot of the decisions in the end, but I think that's a very important one that is about the go/no go of such technology.

And the question is.....I mean I have copied here if you go to the first phase. I don't know if you see it, so I have copied next to the cost versus amortization. Also performance efficiencies and cost and then also the owner. But I'm thinking who would be responsible to provide these costs?

Would it be the architect? Would it be a facade designer? Who can provide that?

Participant 2 (Construction Team)

At least....In Spain at least it depends on the stage of the phase, I mean.

Facilitator

When we're here at the beginning?

Participant 2 (Construction Team)

Usually, a conventional process would be that the client talks with the designer and they probably have an idea of the cost. And then they said, OK, I would invest that amount of million or whatever, and then you offer the construction to a lot of companies and then the one who is making the best cost is going to take the project.

So but in this type of specific buildings, maybe the process is different is like OK you work collaborative. You say OK, you are going to be the construction, the builder, the main constructor you are going to be the designer and I am the client and we work together.

This collaborative thing, of course, it's going to be better than.....probably it is going to cost higher but the processes are going to be optimized.

Because in the other way someone is going to lose money, probably.....the constructor.....the client is going to pay more during the process.....whatever.....I think that probably in the conventional process, this type of technology will not make it.

Facilitator

And that is exactly what [Name of participant 1] had identified, and I think with that it is a very relevant point now, because we also see.....I mean, somebody has to bring this on the table and somebody has to provide also the right information about it in order to see if that makes sense. This also in the feasibility part and then we are already struggling to understand who would that be.

Participant 2 (Construction Team)

For me is the client. If the client is convinced about it, you are going to make it because he's going to pay and he's going to be on board.

Facilitator

How can he be convinced, the clients?

Participant 2 (Construction Team)

That's the main point. I don't know.

Participant 1 (Design Team)

Maybe it is a good thing if there is a design and build design process.....together with the supplier of such a modular façade system, and that could work. And it is a kind of process that has been done for innovative facade solutions. So you need an innovative client, you need an innovative architect and you need a supplier. And if you can bring them together.

Participant 2 (Construction Team)

For sure.

Facilitator

So here if you see....So I added the supplier because we also see them need to have a more central role because if they are only kind of proactive to what then the facade designer will make then. Maybe it's not going to happen and I think that's what we're experiencing so far. So I added the supplier there and actually on purpose, put it between the two phases because I think the supplier need to be able.....I mean that's basically what they do....To put forward all of those things about the safety, the sizes, the weights, but also this balance of cost and aesthetics...I think that's something that the suppliers should also have a central role. I don't know....What do you think about this?

In your experience....Because that's a key thing....We also keep getting back to it....How much is going to cost? Would it be the architect that makes this decision and provide this information? Would it be a facade designer? Would it be the supplier? Who do you see the right person to do that? I'm copying a little bit below this because I think this balancing of cost and other things is very key in the feasibility. Who do you think would be the right person to do that?

Participant 1 (Design Team)

I think you need more disciplines to make a cost estimation. Of course you need a facade supplier, but you will also need the MEP (Mechanical, Electrical and Plumbing (MEP)) supplier for the installations.....And one of the critical aspects of this is that in the facade, you have both building products and installation products. And I don't how that is abroad but in, for example, the Netherlands and the UK, that are different worlds.

Participant 2 (Construction Team)

Completely....In Spain it the same.

Participant 1 (Design Team)

You want to bring two different components together, and that's hard for PV systems, which are quite easy....But for solar thermal it would be even more complicated.

Facilitator

But do you see this as we also need?.....Because I mean of course at some point they have to talk, but they have different processes.....Do you think that we need an innovation also in the type of companies that can do that and is it a supplier that should do this or is it more a consultant, like [Name of participant 1] who works and has colleagues in both aspects?

Participant 1 (Design Team)

Well, as a consultant, I have knowledge of regular systems, but if there is a supplier with an innovative idea, yeah, we combine the information of the supplier with other components that buildings need. So, it is a collaboration.

Facilitator

Yeah, yeah, yeah.

Participant 2 (Construction Team)

To be honest I think if we want to integrate this type of solution, we need a collaborative project in terms. If not, it is not going to be a successful project. We need that the architect is convinced, the client is convinced.....we need the supplier with innovative ideas.....We need the construction company.....We need everyone on board, because if not, it's not going to work, for sure. And I think that's the key point that this type of solutions have not be really conventional ones.....because it's really you are mixing a lot of things there, the passive part, the design part, the active, the installation, the building services, that at least here in Spain are like completely two different worlds, that what we were saying.....That one is the architect that make the building design and so on and he calculates.....the insulation and so on.....the windows.....But then it's an engineer that is making all these installation process and how it works and calculate the energy consumption, the demands, the power of electricity or whatever.....And here we are combining.

So it's really really tricky.....So I think this is not easy for sure.

Facilitator

The thing is, because I mean our goal, we very much identified these issues as well.....That's also what [Name of researcher] started saying about the barriers that we see and so on.....So if we try to think, to organize this process along the way to support.....Because I think what you say about knowledge, but also motivation to do something.....In the end, it does come down to what information do we have to have this motivation to do it. I think that's relate.

Participant 2 (Construction Team)

Yeah, sure.

Facilitator

In the end, who should be responsible for making this step? I mean, of course, in the end the client needs to want it. The client decides a lot of the things and the architect also needs to be open to integrate this into.....but we keep going back to the supplier.....Is it about having a company that provides both aspects? How can we really make this step?

Participant 1 (Design Team)

I think you hit the bottleneck.....Responsibility.

Participant 3 (Design Team)

Yeah. OK, in previous experience.....probably....I and [Name of participant 2], like in the same [Name of a specific project].....So the main issue it was probably a supplier who developed an innovative façade system that at the end they were not taking responsibilities in order to install it.

Participant 2 (Construction Team)

To installation.

Participant 3 (Design Team)

Exactly. So then the construction company or the suppliers who were trying to install the system, they were feeling a sceptical all the time on the system that they were providing.....So this was generating a lot of conflicts between the supplier and the construction company....And as I saw it I and [Name of participant 2] in this thing, seeing it in the past, in the [Name of a Hungarian city] pilot and also in the Spanish pilot [Name of a specific project].....The architect was not dealing with the whole design, let's say.....So this is like.....

Participant 2 (Construction Team)

I think that.....yeah.....I agree with [Name of participant 2] in terms of.....At least here in Spain, the one who is signing the project is the architect. So, he's going to take the responsibility of the design and if something is getting wrong, he's going to be the first one to ask. So you have to convince the architect, for sure.

And then I think that it could be easy if the supplier of the solution is the one who install the solution, and he's the one who explains or help the architect to design the solution too. Of course, for this you need a really big company and a really big issue. But if not, something in the middle is going to take time, effort and it's going to not work because the designer probably doesn't know the solution, so it's not going to integrate properly the solution into the building....If not, the installation process is going to be tricky because you don't know the solution.

So, weather you improve the communication between all these partners.....Or you make like one partner for everything. So for me, that's the key point.

Sorry [Name of participant 1]

Researcher

[Name of participant 1]?

Facilitator

[Name of participant 1] please go ahead.

Participant 1 (Design Team)

Maybe it's good to mention that, for example, in the Netherlands, the architect is not the responsible one for the final solution. It is the contractor.

Facilitator

Yeah.

Researcher

Ok

Facilitator

Yes, it's difficult to say because of course different countries have some different traditions or also way of working. But I think here we have a common line that we see a guy who is the actual responsible.....Like the owner needs to be convinced.....Maybe it's convinced by the architect, or it's convinced by the contractor, depending who's the direct person, people who talk to and, but we also see very big role of the supplier and then having two kind of give all this information that we have and make the decision that we say.....And we also see a gap in kind of the knowledge that is there around such a system and then identify the need to be more integrated. Of course the collaboration, but I do think there needs to be somebody there who really brings this forward, provide this information and I add from the discussion I get that we see a supplier with innovation in the product, because it's an innovative product, and also in the discipline that they bring, that might be a key, a key person to do that.

I would like to go a little bit further.....Also being aware of the time. So let's say that we have convinced the architect of the client. And we go for such technology and have seen that it performs well and can cover the demand.....We heard this for [Name of participant 1] that there are possibilities in terms of performance from here previous experience.....And then we go to Phase C which is about selecting the specific technology we want to integrate and then we also we go towards phase D to actually design this integration and E. So I know that we have to make a lot of assumptions there, but just to be able to say something for all the different stages.....but I think we can continue with this assumption that we have a more innovative supplier that can provide both facade design information and advice and also the performance and the systems and the component information on that. So when we are about selecting the system. I think we have identified here the key decisions, the type of information we want.....So I would like maybe to start with who should be the main responsible to.....which stakeholder to make this decision on the technology and the type of component and then go further towards detailing this facade.

Participant 3 (Design Team)

In our case, it's the designer and sometimes we have a specific consultant for façades and envelopes. So we are both deciding these technologies.

Facilitator

Is it a consultant, like a facade designer.

Participant 3 (Design Team)

Yeah.

Facilitator

So I think we could highlight the architectural designer and the facade designer as the key people in stages C&D.....and then what information would they need? Of course, the manufacturer has already been there.

Participant 3 (Design Team)

Yeah, [Name of facilitator] I also would include the engineer if we are considering systems which are related with energy production or solar cooling technologies. So it's like a triangle.

Facilitator

Engineer we make like the HVAC engineer.....The mechanical engineer?

.....

OK. And then....I put the supplier a little bit to the side, even though maybe then it becomes a more of a square rather than a triangle.....But then let's start with architectural designer, HVAC engineer and facade designer.....What information do they need at this? So we're in the stage when we really try to make the solution possible by designing it and making the system. We know that it works in terms of performance, so we want to really start look at the integration. What do we need? If it's helpful if we can also look at the purple part and also more things that come to mind.

Participant 1 (Design Team)

As a facade designer, I would ask for the components I have to install.....Instructions how to install them.

Facilitator

OK, I will make it....So it will put [Name of participant 1] here and will say information on the components.....What exactly would you like to know? Is it enough to know the size ?.....and I guess which components and the sizes....

Participant 1 (Design Team)

Sizes.....Maybe if some components need to be parallel or vertical.

Facilitator

Size and so on....size OK.....way of connection.

Participant 1 (Design Team)

How it is being connected.

Facilitator

How it can be connected....And then I would say this will be the supplier right?.....To provide that in that case.....Or do we see also that the mechanical engineer would know this?

Participant 1 (Design Team)

Could be both I think.

Facilitator

Both.....May be I put this one here.

OK. Would that be enough for you to do the detailing and decide the facade system?....With regards to this or would you require more things?

Participant 3 (Design Team)

The cost estimation would be also in this is step important I would say so.

Facilitator

To know more detail, because we can assume that the early phases, it was more rough cost estimation.

Participant 3 (Design Team)

Exactly.

Researcher

So we can call it maybe detailed cost estimate to differentiate.

Facilitator

Yes. Yeah. And I also was wondering.....because we got in previous discussion that also regulations can be an issue....I think that could also be a point to look at it.....because before we are still deciding if we're going to do it and we want the basic feasibility. What kind of regulation do you think would be relevant for that? Is it on the energy performance on?

Participant 3 (Design Team)

No I think it would be more related in safety and health, so something related with fire regulation. So if we are installing some innovative system like this cooling system that you are providing....So the element that would be.....assuming the thermal responsibility.....should be also fire resistant.

Facilitator

Yeah, yeah.

I mean, that's always like if....Here we have not specified to what extent this is an already kind of credited product or a solution that is really defined ad hoc...I think a lot of the components are credited product....Evacuation tubes and so on.....So that's something that would comply....But I don't know when it's integrated in the facade, to be honest, if it can already, maybe it needs more testing.....But could that be.....I mean, of course....yeah. OK, that's.....

Participant 2 (Construction Team)

I think that....At least with the Spanish Regulations, you have to demonstrate that all components in the façade achieve the standard.

Facilitator

Yeah, exactly.

Participant 2 (Construction Team)

So of course it's....in terms of insulation....in terms of....probably the more tricky thing here is the fire safety and how it performs when it's fire and so on.....But you to make some calculation on some estimations in order to demonstrate that you achieve the standards.

Facilitator

But calculation would be enough or you need to do also like mockup test and so on?

Participant 2 (Construction Team)

Depends on....If the module is.....If you are selling an entire module for the facade, you should test that module.

Participant 1 (Design Team)

Yeah, we have to see a CE marking on building products and they are only applied for existing products of course. But if you integrate the system in a facade, for example, there is CE marking on curtain walls.

Participant 2 (Construction Team)

Yeah, for sure, yeah.

Participant 1 (Design Team)

An that covers almost everything, like water tightness, air tightness, certain performance, etc.

Facilitator

And the supplier would be responsible to do that....it's not on the contractor.?

Participant 1 (Design Team)

Yeah, supplier.

Participant 2 (Construction Team)

Because you are you are selling an entire product. So you should set with CE marking and so on.

Facilitator

But I think that's another maybe unclarity because it's I think relates to the discussion we were having before.....Like is it building we design or a product we design.....Like the facade, I call them assembly or system.....is the system in the façade.....Then should it be the supplier that provide the solar cooling which is the collectors and the tubes and so on? Who needs to do this CE marking.....That's what I'm thinking.....Maybe the contractor in the end who has to do the façade.....assembles the facade.....Which is an unfair basically because they won't do it.....and I think that's another reason why we keep coming to this bottleneck.

Participant 1 (Design Team)

I don't see that as a bottleneck because if you are a facade supplier and you buy a component for example a tube or a cable or whatever...The tube or the cables should be certified....as easy as that.

Facilitator

But if you integrate it in a system, then [Name of participant 2] said that we need the certification for the system as well, which goes beyond the tube.

Participant 2 (Construction Team)

For me, if you are selling an entire product with all the tubes, all the things, probably you are selling this as a finished product. So probably you need a unit component. So probably for this unit component you need the certification.

Facilitator

OK. So this should be done if you're selling the product. You are the supplier that your business....you have the certification, yes, and then it can then directly be integrated in the facade and it won't be an issue.

Participant 1 (Design Team)

Yeah, but there is no CE marking for solar thermal façades, for example, or for solar facade systems. So you then don't need certification but to have a proof of principle, of course.

Participant 2 (Construction Team)

For example, in the [Name of a specific project] as [Name of participant 3] was saying, we create an innovative solution...We designed an innovative solution.....It is not an active facade, it's just a passive facade.....But in the Spanish pilot, we should install it in a real building.

And the answer that we get from the municipalityas all the components of the façade has a CE mark we don't have any problems with installation of the entire system. Of course they also demonstrate that they may have some fire resistant test and so on. But as all the components of the facade had the marks on all the certificates....it's okay for the installations, no problem with that.....I mean that in his case, it would be the same.

Sorry, [Name of participant 3].

Participant 3 (Design Team)

No, sorry, [Name of participant 3]. It's also happening to us here in the studio....So when we are trying to include some new material or some recycled material in concrete or whatever, it's a change of paradigm.....So you have to assume that some tests will be done before installation....So it's like an extra cost should start being included in all the bill of quantities or you know the works that they've been done. And also [Name of facilitator] when talking about regulations, especially here in [a city on the northeastern coast of Spain], for example, when you are building in the in the main city centre, you have to follow the colour and aesthetic regulations from them. So for example, these kind of systems, probably they never would be allowed to be installed in the city centre.

Facilitator

Well, I think you're allowed to install like a curtain wall facade....Probably this can also be a little bit like that....No?

Participant 1 (Design Team)

I don't think it's needed to acquire a CE marking on the new facade because there is no regulation for that. You can only have a CE marking for harmonised products, and those are very well accepted products.

Facilitator

And then in this sense....because, like the solar cooling consists of different components and then [Name of participant 1] have already mentioned that there is no ready component for cooling.....it's a combination of components. So if those components are certified with this

because they're standard things, cables and tubes and so on, then there's no problem with certification.....doesn't need to certify it as a system as well.

Participant 1 (Design Team)

No, because there is no law to certify the system.

Facilitator

Then we don't need this.

Participant 1 (Design Team)

We only have to show that the combination of the products will not deteriorate. For example, the fire spread regulations....these even add on to an existing façade, and you could do additional tests, but that's not a major issue.

Facilitator

So here I think as I understand, once we decide we want to go for such a system and we already said the supplier needs to come up with some kind of innovative structure to combine both competencies and give all the required information at the beginning. Then the integration is not necessarily.....I mean it's designing a facade and we need to know the components.....It doesn't necessarily require some innovation in this aspect. Do I see the discussion correct? It would be like designing a facade and we need collaboration with the architect. We need to check the regulation and the cost....But it's not that we need some kind of innovation there.....It will be the process and we get the information. What do you think?

Participant 3 (Design Team)

It depends on how you see the product. So if you see the product that you're studying as an external finish component, I wouldn't call it façade. I would call it an exterior finish that could generate energy or whatever. If you are talking about a facade, then you have to provide that the system that works itself and it should provide all the other performance of the envelope, thermal resistance, fire resistant.

Facilitator

But that's what we do in any façade design, right? I think it's not only the finishing because it has also more components behind it. And then if we think that this is going to be integrated in a modular system, and I would also like with that and give you the time again and go back towards the last stage, which is about the actual installation and design for that, which I think whether it's a modular system it.....it makes a big difference.....How do we see this decision being integrated? And I think that [Name of participant 2].....also that's where contractors are coming more into play. How do we go from here to the installation and the modularity that the contractor? Of course the modularity has been decided. But in which phase....Like also the role of the contractor becomes and what information would you need as a contractor?

Participant 1 (Design Team)

Warranties.....First question.

Participant 2 (Construction Team)

First question....And then of course if you are the supplier, you should think about how you are going to install this in the building and the architect. So I will ask what auxiliaries do I need? And I tried to improve that in terms of time and in terms of cost.

Facilitator

Would you get this information from the designer or from the manufacturer?

Participant 2 (Construction Team)

Probably from the manufacturer.

Facilitator

Exactly. So that's why we have the manufacturer....also having a role here.

Participant 2 (Construction Team)

Of course the designer has to be involved and they are going to be the directors of the solution. I mean, they are going to be in order to prove that everything is correct, but I think that most information is going to be provided by the manufacturer.

Facilitator

Yeah. OK. Of course we can discuss more about it, but we want to try to keep the time....So I think we are close to the end of this exercise. And are there any comments, especially regarding those last phases, something you would like to highlight, particularly in terms of information that you would need or processes you would like to highlight? How do we really do the integration and then design and the installation....eventually install it? Especially we talk about systems. In this case, we have solar cooling but also active system, a little bit more general. Is there something that you would like to highlight that could be useful?

Participant 2 (Construction Team)

Just one thing that maybe when you include this type of active system in the facade, you should think about the entire process and the order of the activities in terms that you don't damage the active system while you are working in other things. So maybe you have to think about when you are doing this activity and....I don't know if I'm explaining properly...The thing is that you install something in the facade and then you have to go, I don't know, through it....So you have to take into account the order of the activities in order to avoid it that you damage the system or so on.

Facilitator

Is this a matter of planning the activity that will be more on the contractor side? Or would you require....

Participant 2 (Construction Team)

Yeah, for sure. I think that you require information about what you have to take into account, but of course it's a responsibility of the constructor in order to plan properly the activities and I think in that sense, the link.....the construction is the key point here.

Facilitator

Yeah, Exactly, and I think it can also make a big difference if we're thinking of a modular system that a lot of those things are planned....or whether we call another kind of more traditional construction where more things are added on site.

Participant 2 (Construction Team)

Yeah, for sure.

Facilitator

That could be another reason why more modular systems for the facade have.....as we have some of discussions....have more potential to integrate this.

Participant 2 (Construction Team)

Yeah, for sure.

Facilitator

OK. [Name of researcher] do you have any more remarks or you have questions? Something you would like to highlight?

Researcher

Yes, I'd like to highlight because I think when I was looking at....I took notes.....Things complete. One of the key decisions that have been wrote I think....I forget by whom.....It was not listed among the stages.....I have a question.....Maybe be it was missing.....It was about "Can it be temporary elements to the facade with the advantage of changing facade appearance every 10 years", and then it was mentioned that about circular....So that was about one of the decisions written. If you think about this, which of the phases we or stage.....Does it belong to A, B, C, or D and, who is involved in making these decisions.....about whether it's temporary façade elements or it change every 10 years. I don't know who wrote this decision, but if we think about such decision that was not mapped in the process.

Participant 3 (Design Team)

I don't know....I think it could be probably included in the stage B. OK.....In between A and B, so that the fact of changing an element every 10 years, so the temporary fact it should be included in the design concept stage.

Facilitator

And maybe like....Of course we did mention also at the beginning, the life cycle of the solution, which was a factor into deciding for such a solution, but we didn't come back to it during the other stages of the design. Of course. I think then it's more about maintenance aspect, but for what kind of life cycle would you be designing for? Do you expect that this is a facade that is going to be there for 60 years? Are there these considerations that you would have in the process.

Participant 3 (Design Team)

For now, for example, clients are asking us to make a first approach of life cycle of 15 years.

Facilitator

15 years. OK, OK.

Participant 3 (Design Team)

15 yeah, for new building.

Facilitator

That is not much.

Participant 3 (Design Team)

No, no, no.

Facilitator

I think this system can more or less last that long 15 years.

Participant 3 (Design Team)

Yeah, but it's like always changing.....Like the speech....So see investments shorter than we see building lasting.....So for them it's 15 years, the investment should have a payback.....If not, it's not a possibility. This is why they're considering this in a really shorter time in terms of investment and decision. Also one thing.....The system that you are proposing on your study, it has direct influence with the hours solar.... Like that could generate energy. So it depends on the climate or the location your system would be more cost-effectiveness than the others.....And also the orientation or whatever.....this kind of things.

Facilitator

OK. I think again we can use a little bit the last few 10 minutes to wrap up and also reflect a little bit....So I think [Name or researcher] we are done with the Whiteboard, right?

Researcher

Yes.

Facilitator

So you can change the sharing.

Researcher

Yes, I'm going to stop sharing.

So we are approaching the end.....To reflect on....OK one of the things that I noticed.....I'll start with the second point about differences of my framework with things that have been discussed. One of the things that I found on the pre-workshop survey that have been filled that the supplier actually was not mentioned in the first two stages and now in this workshop it was highlighted that the supplier should be involved in the first early stages while it was the pre Workshop survey it was not that mentioned.....It was mentioned in later stages. What do you think about the differences.....when you went through this activity that I noticed that it was insisted that the supplier should be involved in earlier stages? Why do you think that this have been emerged during this workshop?

Participant 3 (Design Team)

I think it's a problem that the architectural field is facing in general. So the architectural field has a really long heritage compared with modern systems and technologies and industry, so we are trying to fit something which is coming from the historical part with something which is coming from the industrialization. And they are all the time in a conflict. So the fact of including somehow industrialization or industrialized product in the architectural sector or construction sector, it's fighting again how the discipline of the architecture has been built for long term. And new modern disciplines such as engineering or whatever they are, including, always in the design or in their way of designing the industrialization or these storytelling. I would say for us, it's something which is matching all the time. But after the workshop, for sure, I see that it should be included. I mean since the very beginning, yeah.

Researcher

Yeah....Ok, generally like for all of you this question.....Which part like did you find difficult to decide on like within this activity....When we went through this exercise. What do you think the most thing that was challenging to decide on and why?

Participant 2 (Construction Team)

For me is, it is quite difficult to see this type of solution as a reality I mean. To be honest, it's something that is far from being.....Yeah, a solution for the buildings nowadays, at least in Spain.....And I think it's a mix of things that that we said and we were sharing with you in this workshop....Like OK, the solutions are there, the technology are there.....But, the thing is that we are not doing this in our buildings.....So probably because we have a bottleneck somewhere....

Facilitator

Or many.

Participant 2 (Construction Team)

Or many, yeah.....But at least here in Spain I don't know that as [Name of participant 3] was saying, architects are really focus on design sometimes and they concern about this type of things. Now I think that they are changing, but there is a lack of knowledge about these technologies.....So they are the ones who has to implement them.....and sometimes it's quite difficult. So I think it's a mix of things that probably we need more knowledge about them and another thing that is that probably when we try to implement these type of things in buildings, historically they haven't worked or performed as supposed to perform, so people are hesitant about the performance of these type of things. So they prefer to keep simple and convolutional in order to avoid problems. So I think there is a mix of things there and for me, the main point is that is difficult to think about is our building that we can implement this type of solutions.

Researcher

OK about the knowledge.....It's linked to the last question. When we went through this exercise and we tried to outline decisions at different phases.....We outlined information.....People to be involved in.....To what extent do you think that like organizing these things could help in supporting to push it more towards design and development? When we worked on outlining the decisions and information and stakeholders, to what extent like it could support? Consider both it could derive or it could be a concern.

Participant 1 (Design Team)

It could help but I'm thinking that maybe you could look at another strategy...We see that a combination of the different disciplines in one facade is very hard....Not only from technology but also from responsibilities, cost, maintenance, etcetera. So maybe you should think about the separation of the system so that you design a kind of add on system to façade that you can keep those structures between the disciplines that you can keep them as conventional as they are.....But you can't change the building world. You can only change a product. I think that's could be a way to avoid those bottlenecks.

Facilitator

Yeah, it's a good time.

Participant 1 (Design Team)

And yeah, so not to integrate the solar thermal system into the facade, but first try the add on solutions.

Facilitator

Yeah. So would it be then.....I think this also links a little bit of a discussion we're having.....Shall we be looking at the building development or the product development. And I think given what [Name of participant 1] just said and also given the big role of the supplier that we need, maybe we should indeed be looking at the product development that like that feeds to this building development and I think we do need some changes in both. I mean you already mentioned the suppliers need to be more interdisciplinary, but also then be involved earlier on. And yeah, I think that's a little bit what I take and of course and I think then on top of that industrialization in the construction can also provide new possibilities for this add on solution, [Name of participant 1] mentioned, the product development.

Participant 1 (Design Team)

During this meeting, I was thinking many times to the PhD work of Jos Lichtenberg. Do you know him?

Facilitator

I know him, but I don't remember because he did a product development, right?

Participant 1 (Design Team)

Yes, he did a PhD on product development. He was looking into key success factors for successful product development. May be that could also be interesting to think of strategy to make a product like this work.

Facilitator

Good.

Participant 2 (Construction Team)

I really like the point of [Name of participant 1]. Maybe we should think completely different. Maybe think about the building and then how..... I don't know different things. We should change our mind completely in order to make this feasible.

Facilitator

Yeah, I think that's a good way towards the points that [Name of researcher] has here. And yeah, I think we have been more or less touched upon those. I don't know any final comments for anybody else.....No?

Yeah, I think we had enough.....Originally we had planned also small break, but then in the end I didn't want to go to the flow.

Researcher

Yeah, the flow went continuously actually.

Facilitator

So then I think we would like to thank you so much...And [Researcher Name], you have the final word.