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Hello and welcome to our webinar this afternoon

Julio Bros Williamson and Cameron Purdie

Hello, thank you very much Branka and thank you to the CIC Start team for giving us this opportunity to talk about this feasibility study which is clearly something very important within the building industry as you said the title of this is the gap between design and build we are focusing on Scotland working towards compliance of the 2020 regulations as a means of context and guidance but have look at the contents

As Branka said at the beginning this feasibility study has many partners Morrison partnership have a great man of experience in building and designing ourselves at the Scottish energy centre which is part of Edinburgh Napier University I think just as part of introduction, it is important to look into how building regulations have been more stringent, they have started to shift in areas where there is better standards were some better models of constructing and designing, and it is important that that is addressed

And also the living conditions have obviously improved such as thermal comfort which is a big issue these days.

There is a lot of concern around achieving this both in terms of design of the building and also during occupation of them.

So really the objective of what we're trying to look into the report we produced was to make buildings better places to live and also look at ways that can be achieved.

So it's down to compliance of building regulations and also occupancy and thermal aspects.

A lot of these elements will be touched on in this presentation looking at energy efficiency rating of buildings and how this has become an important way in rating how buildings are performing.

Also how they work that's quite an important element, benchmark with regards to the standards, Also looking at various handbooks and technical details which have been published, investigate of design or as a benchmark as well

There is literature such as a Sullivan report in 2007 how that has been very important in the way that policy has been framed around and how building regulations have been introduced and improved so guidelines but really this study has look to the possible sources of this gap there has been identification of a big gap between the design and predicted performance and the actual performance as measured occupancy, so really this comparison between design and build.

Why is the predicted not the same as the actual, whether in the first year of occupation, or even years 2 to 3 years later so where identifying why this gap is appearing some of them may be around design, the complexity of the design perhaps during construction, many people think it is entirely during the construction phase where this gap arises, perhaps in skills so we will try and identify here this gap lies.

further other purpose history about creating awareness of this gap and the causes amongst professionals so were looking at the handover stage and making these points quite clear.

We're trying to look not all the into just one sector, but into new builds, retrofit, and nondomestic and domestic now I will now pass over to Cameron.

Good afternoon, I going to take you to the next few slides which will try to establish the reason as to why we set on the path of the study.

The third bullet point, some of the issues that we established early with a research first of all we identified that for most buildings, you would either be in the category of new builds or refurbishment.

the second area was whether you'd be in the domestic or commercial.

Rather than commercial, you could read non-domestic but we believe that it is important to call it commercial as it widens out the building types that are not covered by much of the research work that is going on with much of the housing-based organisations Many of those organisations such as the Good Homes Alliance and the carbon buzz website have done a huge amount of investigation and some preliminary reports about this whole issue of the gap between design and build.

And we looked and reviewed some of the literature but what we wanted to do was broaden that view outside of housing, to look at the whole area of retail, offices, industrial and commercial premises, schools, factories, because to our understanding there was very little focused research going on in those areas.

most of it was in the area of domestic so is important that we are looking at both domestic and commercial here.

The other area we wanted to look at was the different stages in the building process You may imagine the are I be a line of work but we summarise that into three principal areas the first being design, then construction, and finally management the design section will really take everything that will be precontract that could involve strategic decision-making, detailed design, specification the construction section this really anything on-site and the management looks at not just commissioning but handover and maintenance and those three elements are no summarised in the next slide which indicates to you the 12 streams of research that we believe need to be further investigated.

These 12 strands investigate the different classes and types that we have illustrated, for example if you're working in the domestic sector and you are doing SAP calculations, that is completely different to working in a different sector in using a different tool so you may have somebody in the domestic side who knows how the building works but could the transfer into a commercial sector or perform a different role so we really believe these are separate streams of research.

There will be crossover clearly but we believe these clearly identify the areas to look at one of the things I want to draw your attention to is the carbon buzz website and the carbon buzz information.

Carbon Buzz has the great deal of research are provided a lot of information it is in our IBA and Sibse platform they are already identifying this gap.

In some areas are looking at 50% greater CO2 emission or energy use requirement in some buildings, even 200% of the predicted use in others.

Mostly in schools and offices, the residential is a little closer but the one outstanding and astonishing problem is in the industrial sector, although they'll have much data in that area, we are looking at somewhere in the region of 10 times greater use of energy and CO2 emission than was predicted at the design stage.

So we can't place too much emphasis on that

Because there are insufficient examples for that sector but nonetheless it does highlight the issue a great deal of the research that we hereabouts in this field is very much focused on domestic.

but the real culprits and non-domestic and that is an area where I think Julio and I from our research and discussion we want to address the area and see what moves can be made by further funding to look into the reasons behind this disparity between design and build with energy consumption.

moving on to our next slide the whole origin of this research project it really began with a chance comments that this made four years ago in our offices.

we had just had our CPD presentation on under floor insulation.

we were somewhat jokingly querying whether the installation which was collected in insulation with delivery to the site, handling positioning and installation never mind whether or not it would be able to provide the actual energy savings we thought that perhaps even handling bits of it might get chipped off.

so the actual outcome of energy consumption would be much worse than predicted it was really because of this chance remark that I sat down and started to brainstorm.

what were all the different things from start to finish that were affecting the final result?

affecting the idea of delivery and delivering the predicted energy models it was really out of that that we approached a number of organisations funding and were very grateful to CIC Start online for allowing us to look at this work and providing the funding to look at it as some of the things we have identified are quite worrying with regards to achieving the targets that have been set looking at the 42% target is quite difficult when you consider that 50% of the carbon emissions in Scotland are coming from the construction sector and the buildings in use that is quite a challenging amount of carbon reduction to try and achieve 42%the other thing I want to highlight about target setting is that many of the targets that are being banded around even today were set about decade ago.

Crucially we are going back to before the greater banking crisis in 200- 2008 downturn.

I think that also something we need to bear in mind as to how we achieve these CO2 reductions because a great play was made on how domestic design could help reduce CO2 emissions but in fact the number of houses that had been completed has been reducing over the years.

You might have been looking at 25,000 houses per year, where it's now under 16,000.

There is a concern that we may fall short of the original targets are set 10 years ago Of course the Sullivan report is reconvening in Scotland to review their targets and program and that is very welcome the other thing that concerns me about 2020 is that many people talk about 85% of existing housing stock which will remain 2020 if you take only a 0.

66% turnover that actually computes to a closer like a 95% existing stock by 2020 it doesn't take into account demolition but even allowing for that that is substantially higher than much of the discussions.

I highlight that because clearly there is going to be a shortfall.

The percentage of houses seeking to have better energy standards is going to much less by 2020 than was predicted.

I think that's crucial Finally, the last slide I want to present at this stage is regarding various other organisations have been looking at some of the specific areas, some of the issues that we are seeing are very particular, such as software accuracy and scope such as SBEM and SAPHPC are also looking to continue with their own investigation into the performance gap within housing but is not addressing the issues in the non-domestic Material performance we're looking at the coefficient of performance for heat pumps for example.

this issues there with the ratings are often bandied about by the people selling heat pumps Some of them do not take into account the source or delivery temperatures for example so there are issues there, and perhaps the biggest issue is post-occupancy behaviour.

That is a huge area for research.

I know there are many people looking at POE Again I come back to the nondomestic area there is very little going on in this regard, so in general the slide is making you aware of the much broader picture.

making you aware of the much broader picture I don't think people are aware of the scope of the problem, the scope of the problem.

It seems that is just unmanageable and there is a huge of research required.

I'm going to suggest to you that the main things we need to do now are at the bottom of the slide in red we really need to look hard data I know carbon buzz has made a start at that and that is important but we need to convert that back into coordination and collaboration, not just within the construction but within government policy.

We also have a lack of understanding and therefore we cannot effectively legislate directly We need the government take this seriously, otherwise will be sleepwalking towards 2020Julioit is important for us, before diving into the real problem is to explore what literature was already available Other is in the

form of reports or websites groups were addressing such problems, and also post occupancy studies really looking at some of the areas that were highlighted in these reports our focus as this the beginning was Scotland looking at what has been done in Scotland, what type of buildings have been addressed and what problems have been encountered.

it was also important to look into the Sullivan report, although written and published back in 2007 before the banking crisis, it does point out very important elements that have been highlighted as action points which we should continue on and in this situation in 2013.

We can look at how it has been addressed and look to the future.

Section 1 and Section 7 in the Sullivan report highlight these problems quite nicely but were looking at testing, monitoring buildings, coming up with a catalogue of results or benchmarks of buildings that have already been assessed, looking occupational issues, etc etc

It was also good to start to explore other avenues in terms of different professions, both the design profession and the construction industry as well.

One of them was the RIBA plan of work 2007 Houston industry as a guidance And there is a gap they are, where RIBA hasn't imposed a Step ford testing and monitoring what has been built here is a guidance on design, a guidance on taking the project forward but once it has been completed there is not that approach to evaluation of performance, and we feel that is missing.

A lot of the other documents were published by NHBC Looking at standards in construction and living quality and they have highlighted, the key findings in some booklets and papers for example low zero carbon homes and carbon compliance with tomorrow's new homes.

They also looked software used in such energy predictions which is quite important.

Elm tree Mews developed by the Joseph Rowntree foundation as an example of the building being assessed and inspected very thoroughly in terms of performance, we looked at that too but really in conclusion looking at existing literature.

A lot of literature looks at new build, many of the documents look at domestic problems and buildings in that sector but there is not a mixture of domestic and commercial.

Many of the research has been focused on domestic and new build so really we move on to identifying these problems.

We have explored many of them a lot of around design and construction around the prediction and testing, so let's have a look at where further work is needed in the industry and through the diagram that Cameron showed us was the different types of buildings and stages, we feel that could be tackled the following are some of the areas that we feel are important.

Already Cameron has talked about SAP as being one of the important tools in the design industry.

In the prediction of energy use of buildings That spans in from the fabric of the building to the services that the building will have implemented.

We have really got to put a lot of emphasis on the quality of this software and the information that it has.

If it is accurate enough, a lot of the information is very generic as we evolve as an industry with more more novel tools and building procedures.

although SAP is updated a regular basis we feel that sometimes it is not at the same rate This software seems to be lagging behind in terms of keeping up-to-date with the information.

Sometimes it could be down to the materials they are, or climatic data, or simpler the technology is being used.

So the industry is very dynamic, technologies are very dynamic, is the software as dynamic as it needs to be?

There are ways in which we can make this more accurate.

Perhaps a more iterative model taking the data from existing protections The next section looks at design led aspirations, is the design stage willing to account for all the intricacies that will be encountered later in the building cycle? solar has to be this understanding that what ever is designed needs to have this thought about how it is going to be constructed/sometimes this brings complexities later on so design led specification sometimes were using materials that are well known and we know the values that we can feed into the software but sometimes we are really at the mercy of the manufacturers and their figures that they provide.

and really relying on this information being accurate Most of the information is before it has been implemented it is often tested in factory so there is a difference here between the performance of the material under testing before is being used and when it is actually in use there are two different efficiencies as such that need to be taken into consideration relying on third-party information is quite a big issue here another topic obviously is on-site workmanship the quality of the end product are we relying on workmanship as it stands are the trays shifting and modernising themselves to use new materials and new standards, new ways of building.

At design stage we have a set of guidelines we have to take on board.

SAP scores as good as possible etc But is the building trade aware of this are the evolving at the same rates as the materials are using? Also looking at retrofit and whether we are aware of whether people are knowledgeable enough on older properties is everyone aware of how to integrate with old materials implications of all materials which they are unfamiliar with? That can bring in problems which will later showing the performance of the refurbishment of the building and add to this gap that we are trying to eliminate.

In the reports we had quite a lot of examples that we had be involved in camera looking at the design aspect and Scottish energy Centre looking at energy, heat loss, elements in which it is quite evident where a lot of the gap could appear.

A lot of these gaps are during construction Things have been missed or badly installed.

and we have some photographs here for example gaps in the structure like concrete slabs that have not been filled properly for whatever reason we have paperwork going through different layers of the building fabric without adequate insulation to combat a leakage around it.

We have missing installation in some areas, for example near the eaves in some areas where there are enormous gaps of heat loss.

And on to the retrofit area where we have the complexity of generations of different pipework.

so we have to integrate new with old pipework.

All that amounts into this percentage of increased energy use.

Part of construction is on-site communication, as we know when we design, we'd aspire that the project would continue with no problems, but the sequence we have envisioned will go smoothly but we know that doesn't always happen isn't always the case and so as things change and evolve between vacation needs to be delivered effectively to all the trades variation and have elements that are difficult to predict for example client changes during construction we may have delays for whether or budget all these amount to change which is to be communicated on site .

And finally we've got the post construction testing which, together with the applicants behavioural patterns of building allows us to measure the performance.

Whether by fabric of technology that has been applied but that technology has to be performing properly, and that testing has to be carried out properly which requires knowledge and experience on part of the people carrying out the testing.

sometimes a lot of the technology, because of the nature of the industry, is focused on new build so we felt it was important to monitor retrofits because is a whole different ball-game in terms of materials etc occupant behaviour patterns, difficult to predict during design time and if predicted during SEP or any other simulation most of the times that occupational use or patten is modified and some behaviour simply is not taken into account this is where social patterns come in You have different elements of predicting this and also the technology that can measure the actual energy use, and we can see whether is as predicted.

I'll pass you back to Cameron now to talk about the approach Thank you Julio I'm going to talk from the bit about the diagram we have on-screen here This diagram is to 3 dimensional conversion of the two-dimensional tree that we mentioned earlier We've taken that diagram and put into this XYZ coordinate to show the process that might be followed over time the y-axis shows the difference between domestic and nondomestic and the Z dimension which is really taking what might you regarded as new build up to refurbishment So we began to identify the various areas where research might be needed and you can see the numbers here relates to the various 12 research strands that we identified earlier.

Amazon these square planes you can see some of the issues start to occupy these different elements this diagram shows is the complexity of the whole performance gap issue from start to finish, across all sectors across all types.

I'm not really going to dwell any more on this diagram, we could perhaps look at it later in the recording but is important because it starts the model problem.

we may well take this further.

Back to Julio who will take us through some of the processes we identified to try and shrink this gap.

So there is a big distinction between new build and retrofit.

with retrofit, we really have to investigate what we have to start making a survey of the current performance of the building.

addressing the fabric is really important the fabric performance is the main driver here so using infrared thermography and looking at ways of insulating properly with retro fit or from the actual new build perspective.

we really look at detailing as much as possible any fine details of junctions and joins.

we could very easily design something where every 600 centres with no real problems in the predicted side but want to start building that it could be that there are repeated studs for some reason because of various changes on site or what ever reason

By having these unforeseen elements we could have greater heat loss or some unknown thermal bridge occurring all these elements are very difficult to model and to predict, so the be more focus on these elements such as ventilation shafts etc.

In summary we're looking at some kind of feedback mechanism that can put values back into the software predicted U-Values against actual U-Values.

The disparity there in some cases is enormous.

The same goes for building services.

We now have more complex approach to buildings we have these so-called intelligent buildings from the actual controls of the buildings to the use of energy, whether it is for keeping buildings warm etc

So we have this vast array of complex systems these days are buildings but we know that with unenhanced fabric of the better details and better inest fabric the heat loss is less therefore our need for energy will be less.

So analysis of building technology and services is key and also trying to get a lot of tools and prediction software to adapt at the same rate as a lot of the changes in fabric is difficult, particularly with regard to these new technologies.

Refurbishment is important as well in trying to implement new technology, new pipework into current plumbing systems in the way, we survey that, and look into that is vital too.

Hopefully that will reduce this gap in performance maintenance is a key part of building services not just sizing technologies also having maintenance regime that is set at the beginning of building, during early occupation and Libya set times during the life cycle and finally we look at the building user this problem of awareness of new technology, there is new fabric being implemented in the building solicitor different thought process in terms of using energy and the behaviour patterns within the building many designs are designed with a specific number of occupants in mind and in some cases the end-user may change their mind Or if the property changes hands, it may change the use of various rooms or the number of occupants in the building and this would bring in various occupational hazards.

Could I reinforce a point here, I think carbon Buzz is a good platform for information one of the things I really like about it is that identifies two key issues in mostly non-domestic properties.

It identifies two key issues lighting and unregulated electrical use.

Lighting is easy to understand with left the lights on and gone home, but with unregulated electrical use, this covers all the appliances that we use without them being part of the starting set-up.

it is very difficult to predict We're really looking at understanding of the building user A lot of the time the technical information is very unfriendly to the user, so disparity on the actual use is important.

We see a significant increase in energy use over the years as more of these are regulated devices are added.

unregulated devices are added.

Cameron

This slide is demonstrating that in general is a huge need for cultural change.

All of us need to take a huge long hard look at what we are doing in much greater detail than what we have done in past.

Authors will need significant training in order to come to terms with the standards that we are to be working to if we're to achieve the targets set by 2020.

Also in terms of continuous improvement, we wanted to just summarise a few points here.

We have spoken repeatedly about POEI know that does particularly with the housing sector but needs to be examined much more closely in the non-domestic sector, as I believe even just glancing at the figures that as a significant problem

Also, in terms of the completion certificates that are given to properties both domestic and non-domestic

We were talking about this just before the presentation, we were discussing the certificates you have to submit some air test results, acoustic results, electrical compliance, but nowhere along this line is there anything that relates to energy.

in the sense that there is no in use submission, you will have your simulation as part of your warrant.

But in terms of prediction versus actual energy certification there is nothing there.

there is no going back to account for the building's performance.

of course we now have the energy efficiency performance certificates which should be displayed but by and large There should be some kind of mechanism for bringing together the energy likelihood of the building at the point of completion and giving us a better handle on the performance of the building in terms of energy.

I think that's where the plan of Works document could be important so just onto conclusions Julio We are preparing ourselves for better standards and regulations and there is no better time than this to understand these new issues arising with this gap.

the Sullivan report, they are reconvening it be good if more focus more emphasis was on this benchmark of performance so that people could relate to that whether is during the modelling and design stage or whether it is in the post-occupancy side.

We feel the Sullivan report should be addressing this and hopefully the expert panel will.

but we need more data.

We need more testing facilities in Scotland that is important for us

A lot of the manufacturers at developing products in Scotland need to get the products tested down England this is a big concern for us is a cost involved in this.

So we need testing in Scotland related addendum to software to keep up-to-date particularly with data in Scotland so refurbishment is important as well.

Many of the predicted performances are linked to a economic cost model.

If these predictions are not true and the building is just not performing as designed as stated.

The economical payback will be enormous and many people will be aware of this and not engage.

This is important in terms of refurbishment I'm not going to in to the detail of the slide on the screen however we see this as a scoping exercise in order to stimulate further work once we have been carrying out this scoping exercise it will begin to start feeding into more focused research work It will give us a proper understanding and base from which we will be able to coordinate different organisations or different people looking at specific areas Within our own silo of information they will be able to share that, because as you can see from that three-dimensional diagram, there is a great deal of cross-fertilisation between the different sectors between different building types.

And this of course from the research will lead to action which makes sure the authors as designers and construction workers will have this cultural change which significantly leads the reduction of CO2 emissions in industry and this slide I am just going to leave with you, if you just take for a second to read this text is in red.

I wrote it late one night the danger is that, within the construction industry and building management, carbon reduction and energy efficiency will plateau long before 2020 that is one of the main concerns we have.

And I believe in my heart much of what we have shared with you today, the reason why we may fall short of some of these targets is simply because we are not engaging properly today with where the gaps actually exist and the main aim today is to share with you those gaps and share with you the thinking so that perhaps all others can begin focusing our attention

Thank you to Branka Craig and David for all the hard work and helping to put this webinar together, thank you very much

We will now continue with some questions and comments from our online viewers.

this question from Tony Cowling.

my main concern is the use of internal linings in masonry built homes i.e.

blobbed and dogged plasterboard allowing air infiltration on a grand scale leaving the occupier living in nothing more than a plasterboard tent all be with the majority of the insulation in the walls being thermally bypassed.

Heat loss by design up party walls is still a problem typically party walls are uninsulated and aerial leaky Outside a leading to heat losses are not allowed for in calculations

yes this is an important issue I am curious and perhaps the speakers could elaborate Has your research to date highlighted three core areas to the performance gap i.e.

calculation gap in the numerical building design software responsibility gap in on-site building practices and education gap in end-user behaviour?

yes those are the three main areas I feel the occupancy is a difficult one of the three Obviously you're dealing with people who are mainly not technically aware.

They are landed with this new building is supposed to be energy efficient efficient but they have no instruction on how to operate that building or a live with it, so I think occupancy is the tricky one of the three.

on the design front it is not just about the calculations it's also that many of the decisions that we as designers take in terms of the specification, in terms of the systems that we may put in many others misunderstand or misapply we put together our concoction of systems within houses some of which work against each other so it's not even about calculation or modelling it's also about designers having a much better understanding of the systems that their composing

And also the manufacturers out of industry have to be realistic about the coefficient of performance, especially of heat pumps, that's such a huge problem area within the construction sector it's not just about the availability of people on site but it's actually about the growth of off-site construction, especially within the housing sector because by and large samples of site large fabricated panels like

SIPS they will bypass many of the problems that were identified earlier there is less to go wrong on sites you might say, so should we be encouraging more off-site fabrication and encouraging a greater level of product guarantee?

But there are also opportunities for more people to come to the market with control innovation and sensor innovation from day one at the specification of design stage.

In order to bypass supporter behaviour occupancy will simply leave lights on, if we can get on top of that by using these techniques perhaps there is some solution.

next question the role of BIM in the future of this kind of research what is the real cost application for the homeowner?

I think the focus should be on retrofit since there are fewer new buildings.

Homeowners are not solely interested for cultural change and challenge that is emerging from our ongoing study.

next question Do you not think that if design and construction details were submitted planning stage for approval, the gap between design and construction would automatically decrease?

Very often the most significant savings that can be made in reducing carbon dioxide emissions will be made at the strategic planning level.

The earlier you make decisions about that, the better.

I agree with the commentor

Do you know of any incentives the building owners or contractors to pay for POE?

no, I'm not aware of any intention to introduce this as a statutory requirement.

retrofit has to take centre stage between now and 2020.

In almost all developed countries retrofit has to take centre stage.

cultural change was touched upon Recently I read in an article in a magazine.

It said culture eats policy for breakfast I think we all have to be mindful of that culture devours policy for breakfast.

You can set any amount of legislation, you can set any amount of policy-making, at the end of the day it will be dictated by the trends and the culture.

It will be dictated by how the people implemented that will be the issue I hope that by today and airing the issues that we have spoken about will raise the profile of this issue.

might be useful to associate a wait to different phases design and construction management, so to understand where it is better to invest in a specific context in order to effectively bridge the gap.

yes we have in the papers here!!If you can see this we have tried to add weightings to this two-dimensional diagram we have used colour and shading on this diagram to try and wait these different aspects.

so is really looking at delivering the most efficient measures to deliver the best energy reduction by 2020, and so yes, weighting each of these aspects is important from a cost benefit point of view

I'm looking for further funding for further research to develop a stronger picture to be able to influence government legislation

I do agree with many of the comments that have: that there is a dire need for this.

I think that's where the monitoring and post-occupancy evaluation projects come in analysing the weighting of different stages and their followers to make a decision about the priority of each of these problems.

for example cooling in buildings which may be more prevalent to southern climates this study is more of Scottish-based thing but the further north you come, the really is anything in Scotland that we can see acting to help this legislation because cooling is not always relevant.

overlooking energy consumption it's more about heating and hot water okay I want to draw attention to our forthcoming events sustainability and energy efficiency of three new buildings in Aberdour, Fife.

Edinburgh Napier University we then have a conference on 29 January on LED lighting quality and performance this will take place at Glasgow Caledonian University and now the 6th February we have a conference on the use of recycled materials in construction and be in the Lighthouse in Glasgow.