Smart Building Readiness Progress Since 2017

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PROVIDING ENGINEERING EXPERTISE & RESOURCES ACROSS BORDERS

Table of Contents

1. Introduction

In Feb 2017 the Buildings Performance Institute Europe (BPIE) published the paper, "Is Europe ready for the smart buildings revolution?" http://bpie.eu/

The report graded the building stock of EU countries against the Smart Building Readiness Index (SBRI). There were 15 indicators selected by the BPIE which can be seen in Figure 1 & 2.

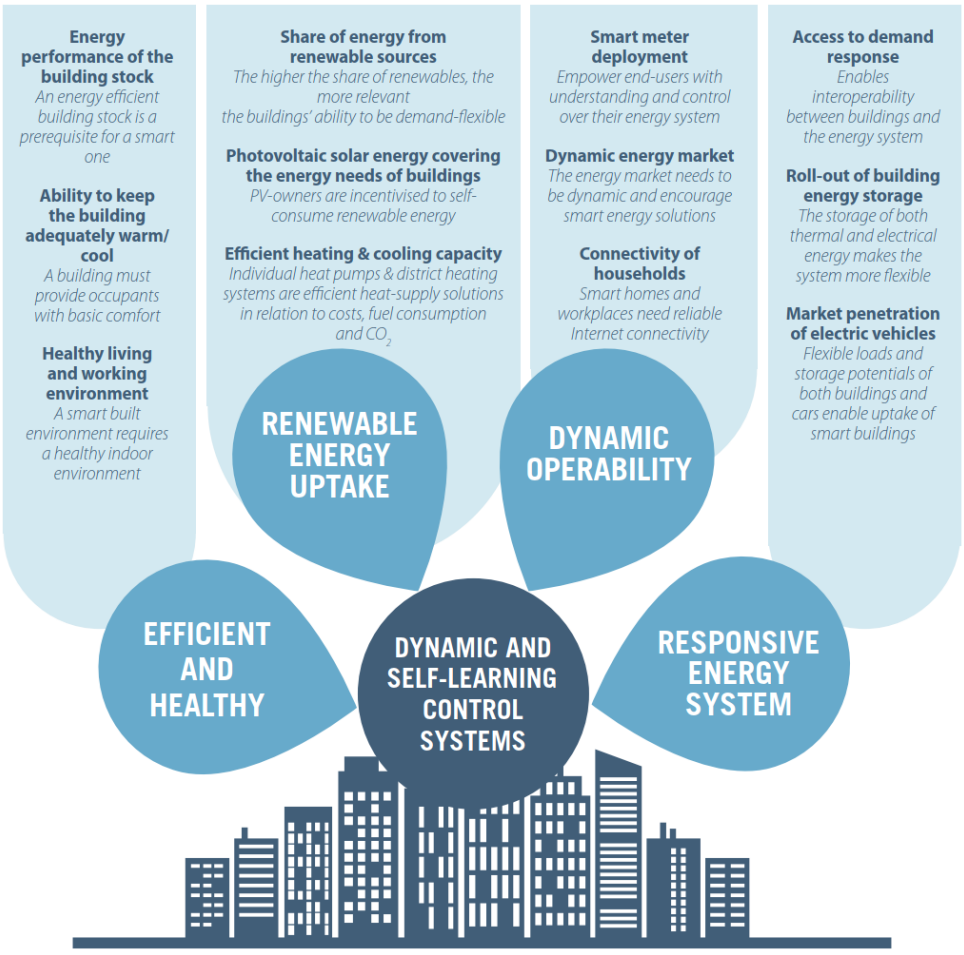

Figure 1. Smart building indicators selected by BPIE (Is Europe ready for the smart buildings revolution?)

Each indicator was rated and the result was an assessment of the smart readiness of the building stock in each EU country.

2. Objectives

By interviewing First Q Network members, the objectives of this report are:

- To see how the situation has changed in each country since 2017.
- Understand the latest trends in the market, customer needs and industry challenges.
- Highlight opportunities based on the trends, customer needs, challenges and the strategic actions being taken by one country that could be applied to another.

During November – December 2020 interviews were carried out with 11 different company representatives from the First Q Network to get a snapshot of the situation in 2020 and asses how the smart building indicators have moved on in three years.

It should be noted that in carrying out the interviews in this way there will be differences in the way different interviewees perceive certain indicators in their own country, depending on their experiences. It is therefore acknowledged that what one interviewee rates as "slow progress" may been seen as "steady progress" by another. Even with a certain level of subjectiveness the combined responses of all interviewees give a good overall picture of the direction and trends being seen in Europe today.

The comments throughout this report are based on interview comments and unless specifically referenced are the opinions and comments of the interviewee.

3. Situation in 2017

In 2017 the Buildings Performance Institute Europe (BPIE) assessed the smart building readiness of the building stock in all 28 EU countries. Figure 2 shows the results of the 15 indicators that were used in the assessment. The assessment considered both commercial and residential buildings.

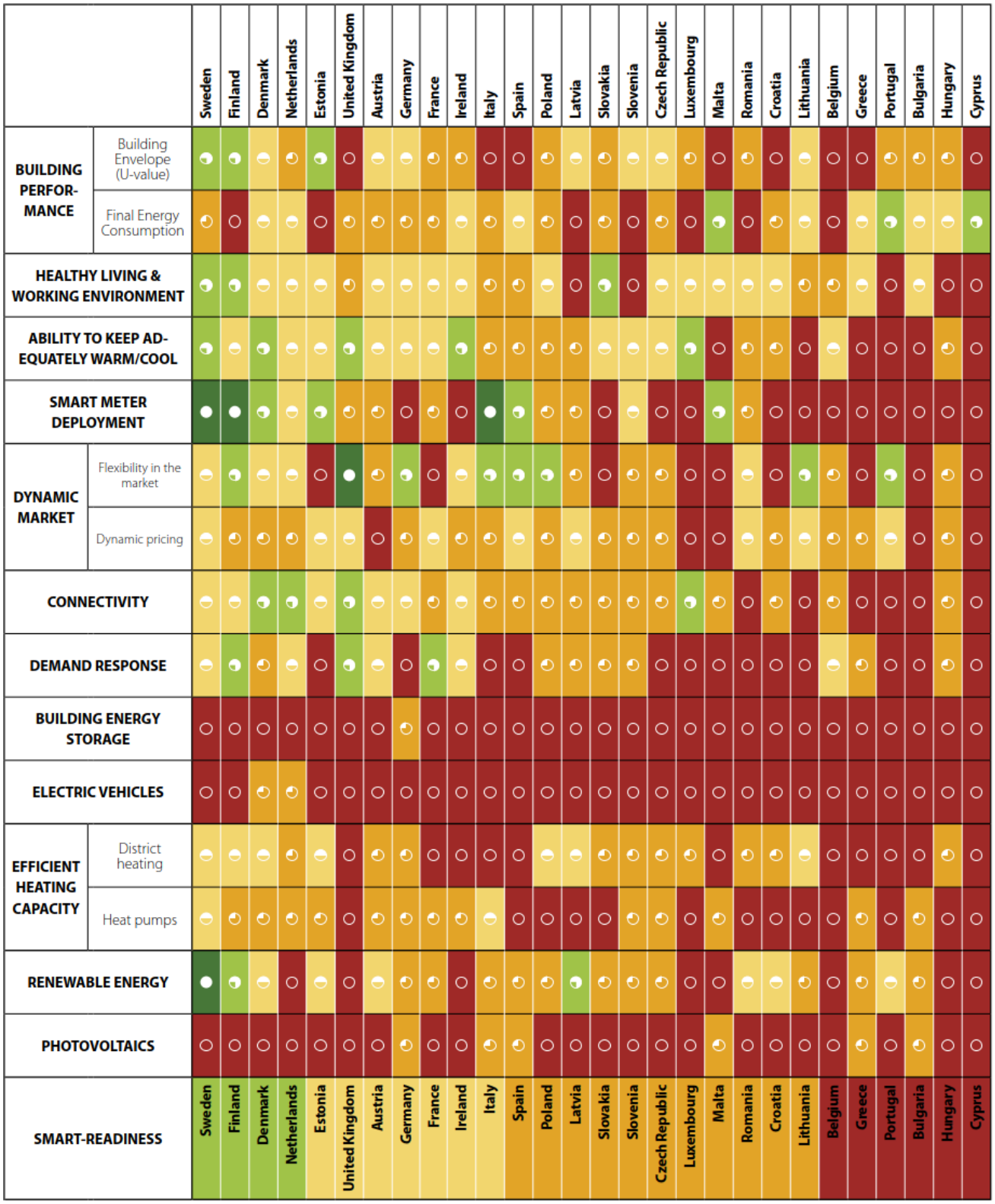

Figure 2. Smart readiness indicator results (Is Europe ready for the smart buildings revolution?)

Using the results in figure 2 as a baseline the next stage is to see how things have progressed between 2017 and 2020.

4. Country Interviews

4.1. Belgium

The interview was carried out with Wim Boone, Business Development manager with Ingenium nv.

Ingenium offers a range of building engineering services such as Building Services Engineering, BIM Management, Sustainability and certifications, Building Simulations, Energy Efficiency consulting and other services.

Ingenium's main segments are Government, Industry, Biotech laboratories, Offices, Education, Large Scale residential buildings, Datacenters, Culture, Retail and Logistics.

There are around 90 employees and the predicted turnover for 2020 is approximately 11M€.

		2017	2020	
Building Performance	**Building Envelope (U-value)**			Some improvement. In commercial buildings the envelope is at a high level. Focus also on the correct positioning of windows and shading.
	Final Energy Consumpt			Often the biggest driver for smart is energy cost.
Healthy Living & Working Environment				Steady improvement in commercial buildings.
Ability to Keep Adequately Warm/Cool				Not an issue for commercial buildings.
Smart Meter Deployment				In new or renovated buildings energy metering is required.
Dynamic Market	**Flexibility in the Market**			Some change.
	Dynamic Pricing			Not readily accessable (except for day/night rate) and limited to large energy consumers to balance the grid.
Connectivity				Steady improvement.
Demand Response				Some demand response. Grid is not developed for bi-directional communications.
Building Energy Storage				Very low interest. Most buildings do not produce more renewable energy than they use. Some geothermal.
Electric Vehicles				Steady growth but still missing the infrastructure.
Efficient Heating Capacity	**District Heating**			Government is investing.
	Heat Pumps			Despite low gas prices vs electicity many customers still want to move to heat pumps.
Renewable Energy				No new buildings are built without some renewable energy source.
Photovoltaics				No new buildings are built without some renewable energy source, usually PVs.
Smart Readiness				Slow/Steady overall improvement since 2017

Figure 3. Belgium smart readiness indicator improvement 2017-2020

In 2017 Belgium was in position 23 out of 28 countries, based on the BPIE Smart Building Readiness index. Based on the 2020 interview there has been:

Fast improvement two areas:

1. District heating due to government investment.
2. Heat Pumps. Despite low gas prices, compared to electricity, customers still want to move to heat pumps.

Steady improvement in six areas:

1. Final Energy Consumption. This is important as often the biggest driver for smart buildings is energy cost.
2. Healthy Living and Working Environment. Project developers want 'something else' and want to keep their tenants satisfied; so, they now ask for air quality, good connected buildings, smart and healthy buildings.
3. Smart Meter Deployment. Now required in new or renovated buildings.
4. Connectivity. Steady year on year improvement.
5. Electric Vehicles. There has been steady growth in sales but still missing the infrastructure.
6. Photovoltaics. No new buildings are built without some renewable energy source, usually PVs.

Belgium has made slow/steady improvement since 2017 and has an improvement value of 24 (see Fig. 14).

Market Overview & Trends

- Belgium was seeing new trends in the working culture before COVID-19 and this has now been accelerated. There is a co-working boom in the larger cities.
    - Workplaces need to be flexible (extra conference call rooms, focus bubbles, smaller/larger meeting rooms, etc. are frequently being asked for) to adapt to the continuously changing needs of the workforce. At the same time employers want to monitor the use of these type of rooms to prove their worth and determine the need for more/less rooms of this type. Add social distancing because of COVID-19 to this mix and occupancy analytics are arguably the most popular smart building feature in the upcoming period.
- Some investors are really taking a lead in the smart building market. Tenants are willing to pay more. Should create a snowball effect between the investors.
- Clients are open to using PLCs for BMS and it is seen a lot. Clients say they pay a lot for the traditional BMS system from large companies and then they also pay a lot for the maintenance and they feel they are not getting the value. The companies using these PLCs are complying to specifications.
- Key trends in the next five years are likely to be:
    - AR, AI, Big Data, BIM maturity, energy demand response, smart grids, user experience and user interaction with the building/workplace.

Challenges

- What is the perception of smart? It means different things to different people.
- There are lots of discussion around data, apps and more sensors but it's not common yet. It's not clear who is going to make the apps and the value is not shown on a scalable way.
- Silos are created as large suppliers want to use their own platforms, but who's responsible for the ecosystem?
- Some companies coming with advice on data, but they disappear as they cannot provide the full engineering package.
    - Combine the knowledge of the experienced engineers with the software knowledge of the younger people. Create more automation in design, BIM…
- Gas remains very cheap compared to electricity and has an impact on profitability of sustainable cases.

- The market is very price sensitive.
- How can there be more efficient use of data analytics for optimization?

4.2. Finland

The interview was carried out with Jukka Karhu, Head of Building Automation/Smart Buildings, and Ken Dooley, Smart Buildings Technology Director with Granlund.

Granlund specialises in technical building services design, consulting and software. Accredited for environmental certifications, BREEAM, LEED, WELL….Granlund Manager is the leading maintenance management system in Finland. Remote monitoring and analytic services ensure buildings are operating efficiently throughout their whole lifecycle.

Granlund's main segments are Healthcare, Data Centres, Retail, municipalities, Offices, although active in most segments.

There are around 1000 employees and the predicted turnover for 2020 is approximately 100M€.

		2017	2020
Building Performance	Building Envelope (U-value)		No major change since 2017.
	Final Energy Consumpti		Getting better, but no radical change.
Healthy Living & Working Environment			No major change. It was good in 2017.
Ability to Keep Adequately Warm/Cool			Not an issue for commercial buildings.
Smart Meter Deployment			Full marks already in 2017.
Dynamic Market	Flexibility in the Market		Easy to change utility supplier and there is a large choice.
	Dynamic Pricing		Steady progress, also for residential.
Connectivity			94% of households have internet access (2019)
Demand Response			Some aggregator pilots. Used in industrial facilities.
Building Energy Storage			No change.
Electric Vehicles			Sales have been rising steadily since 2017, but not using batteries as building energy storage source.
Efficient Heating Capacity	District Heating		No major new network installations.
	Heat Pumps		90% of new projects using heat pumps or hybrid solutions.
Renewable Energy			Wind turbines growing since 2017.
Photovoltaics			Photovoltaics have increased since 2018.
Smart Readiness			Slow overal improvement in the last three years but was classed as a front runner already in 2017

Figure 4. Finland smart readiness indicator improvement 2017-2020

In 2017 Finland was in position 2 out of 28 countries, based on the BPIE Smart Building Readiness index. Based on the 2020 interview there has been:

Fast improvement in one area:

1. Heat Pumps. 90% of new projects are using heat pumps or hybrid solutions. Customers' CO2 neutral targets/roadmaps and corporate environmental responsibility are driving forces for energy recycling and an opportunity for Granlund, with high technical competences in heat pump and hybrid technologies.

Steady improvement in two areas:

1. Dynamic Pricing. Steady progress, also for residential.
2. Electric Vehicles. New sales have been rising steadily since 2017.

Finland has made a slow improvement since 2017 and has an improvement score of 15 (see Fig. 14) but was already second place in the table in 2017.

Market Overview & Trends

- Granlund are implementing a new organizational model to facilitate better co-operation between design, project teams are lifecycle services teams. There will be more focus on the lifecycle of the building.
- Granlund have just launched a "Corona Air change Inspection" service that includes installing CO2/temperature sensors and auditing over a period of weeks to provide a report with recommendations, based on actual conditions and sensor data.
- Often, investors/building owners do not see enough value in investing in smart solutions that do not directly increase profits. End users/tenants are not ready to invest if it is difficult to prove operative improvements.
- Currently the Smart Building team is a virtual community of people in different parts of the organization. In the future this may be a specified team.
- There isn't really an organization driving change, however:
    - Honeywell, siemens, Schneider have brought IOT and cloud services to the market and these have pushed smart buildings forward. The challenge is that there may be too much dependency on one supplier, even though it may decrease the integration costs.
    - Customers with green values and strategy are bringing this to the table early on and it impacts the design. They want to prove they are walking the talk.
    - COVID-19 has brough more acceptance of digital things and connectivity of buildings to 3rd party services.
- Key trends in the next five years are likely to be:
    - The office environment may change partly to more of a Co-working hub, or Office/Hub/Home hybrid model. This is already driving service development and flexible office spaces.
    - Services you interact with at work need to come nearer to home. Could be a loss of real estate value in some areas away from metro or without services nearby.
    - High value, high spec real estate in the best areas needs great services.
    - Where we spend time will change, driven by convenience or services.
    - There will be more spaces planned for multi-uses. i.e. students in building in daytime and different use in the evening.
    - Generation Y, Z will require more apps and technology in the building.
    - BMS designer will consider the connectivity with the other systems and services in the future (Cleaning, food, etc).
    - There will be more focus on data and use of data. Granlund could be a data flow designer.
    - TCO is becoming a bigger topic and the requirement for real time dynamic information throughout the building lifecycle is driving data platform development. Granlund is developing new services based on this drive, investing in their own capabilities and technical solutions.

- "People flow" solutions, user experience and health issues are becoming more important when selling/leasing spaces.
- EU level standardisation (e.g., Smart Readiness Indicator) will set new requirements to invest in smart solutions.

Challenges

- If there is no end user (tenant) the construction company will look mainly for low CAPEX.
  - Without a tenant one option could be to design a building with a 1–3-star Smart Building Rating.
  - Educate stakeholders so they understand that quite a small investment in the smart building infrastructure would provide a good return and raise the value of the building.
  - Granlund smart building consulting team are in many cases involved too late in the project.
- Operation and maintenance is being discussed too late and often Granlund is not involved with the OPEX phase.
  - There are a lot of smart tools that could be integrated if operations are discussed at design stage.
  - It is costly to build data integrations if they are not taken into account at design stage.
- There are still too many silos and we cannot see the whole ecosystem. We need the platform to connect all systems.
- There is a need for cloud-to-cloud level integration to create new value to users.
- Focus is on energy but there should be more focus on the data and other end user services.

4.3. Ireland

The interview was carried out with Brian Coogan, Director of Intelligent Buildings with Ethos Engineering.

Ethos Engineering provides mechanical and electrical consultancy services to the residential, commercial, retail, data centre, sports, leisure, micro-electronic, healthcare, educational, municipal, high tech and pharmaceutical sectors.

There are around 130 employees and the predicted turnover for 2020 is approximately 15M€.

		2017	2020
Building Performance	Building Envelope (U-value)		No major change in last three years.
	Final Energy Consum		There has been high focus on energy reduction. Further reductions possible with data analysis.
Healthy Living & Working Environment			Focus on Placemaking to creat a space people want to be in. Colours, seats, green plants....
Ability to Keep Adequately Warm/Cool			It has been good for many years.
Smart Meter Deployment			Started in autumn 2019, 250 000 meters to be replaced by the end of 2020. Rollout complete in 2024 (ESB website).
Dynamic Market	Flexibility in the Market		It was easy three years ago. Still the same.
	Dynamic Pricing		No major change in last three years.
Connectivity			Fibre roll out increased.
Demand Response			Available for large energy consumers.
Building Energy Storage			Some change.
Electric Vehicles			Government pushing EVs. All new cars electric by 2030.
Efficient Heating Capacity	District Heating		Some change. Irish District Energy Association formed in 2018.
	Heat Pumps		Continous growth since 2013.
Renewable Energy			Wind turbines are growing steadily.
Photovoltaics			Popular on residential roofs.
Smart Readiness			Slow improvement

Figure 5. Ireland smart readiness indicator improvement 2017-2020

In 2017 Ireland was in position 10 out of 28 countries, based on the BPIE Smart Building Readiness index. Based on the 2020 interview there has been:

Fast improvement in one area:

1. Healthy Living and Working Environment. Placemaking (integrating design, amenity and community to create a unique space where people want to be) is becoming and important trend as CEOs are concerned about talent retention.

Steady improvement in four areas:

1. Final Energy Consumption. There has been high focus on energy reduction for many years and most measures have been taken. Further reductions are possible with data analysis.
2. Electric Vehicles. The government is pushing EVs. All new cars to be electric by 2030.
3. Renewable Energy. Wind turbines are growing steadily.
4. Photovoltaics. Popular on residential roofs.

Ireland has made a slow improvement since 2017 and has a score of 16 (see Fig. 14) but was already in the top half of the table in 2017.

Market Overview & Trends

- Ethos Engineering see Digital Consultancy services as a priority and Brian Coogan has been recently recruited to lead this initiative.
- IT and FM teams are starting to have more influence during specification and design stage.
- CEOs are concerned about talent retention and Placemaking is becoming and important trend.
  - For example, it can now be seen that staff retention in the The Edge (Amsterdam) has gone through the roof.
  - Productivity is a focus. There is more return on saving 5% of people costs compared to 5% of energy costs.
- Now it is a user centric market, and they are the driving force. Users want the data, even if they don't know why yet.
- There has been focus on energy efficiency for many years and "no big lever to pull" anymore. Further savings need the use of data analytics.
- Data and digitalization will help show the CAPEX / OPEX relationship. You can prove the building is working to design with this data.
- New business models have appeared. The Electricity Supply Board (ESB) is offering Lighting as a Service solution to upgrade to LED lighting with no CAPEX.
- Urban planners are now talking about the 15-minute village. It used to be 30-minute city, where work, recreation and commerce was 30 minutes from your front door, but post covid workplaces are going to be more distributed and so services will also need to be more decentralized.
- Other key trends in the next five years are likely to be:
  - Digital tools at scale,
  - Cloud, Big data, Digital twins, Engineering digital twin.
  - Concierge services.
  - Safeguarding with the use if tech (measures to protect the health, well-being and human rights of individuals)
- Digital tools will Improve sustainability and optimize the building. Only digitization will allow us to achieve net positive building goals.
- WELL, BREEAM and LEED are all helping to drive awareness.
- WiredScore (Assessment for digital infrastructure) is being used in Ireland.

Challenges

- Tech houses will be our biggest competitors in 10 years time. The intelligent use of data will bring transparency. Management and soft skills will still be needed though.
- There is a need to work with and integrate with other suppliers to provide smart building solutions. This is both a challenge and an opportunity.
- Engineering companies trying to develop software at scale. You need twice as much money to update it and maintain it. Do not have a digital mindset.

4.4. Sweden

The interview was carried out with Samuel Reinwalds, Business Development manager with Bengt Dahlgren.

Bengt Dahlgren offers MEP Design and consultancy services, Indoor condition monitoring, Fire safety design, Sustainability, Accredited for all sustainability certifications, BREEAM, LEED, WELL…. 12 certifications in total.

Bengt Dahlgren's main segments are Commercial, Skyrise buildings, Arenas, residential, government, hospitals, some data centres, some industrial.

There are around 550 employees and the predicted turnover for 2020 is approximately 62M€.

		2017	2020
Building Performance	**Building Envelope (U-value)**		Still a focus but it was already good in 2017.
	Final Energy Consum		Focus is more on CO2 and sustainability. This also improves energy use. 80KWH/m2 is maximum permitted in Sweden.
Healthy Living & Working Environment			WELL used more than in 2017 and some clients starting to use more. In contracts and tendering documents we are seeing reference to healthy living and environment. New regulations also refer to this.
Ability to Keep Adequately Warm/Cool			Comfort cooling in residentials is becoming more of a trend.
Smart Meter Deployment			Full marks already acheived in 2017.
Dynamic Market	**Flexibility in the Market**		New types of contracts available, easy to change supplier.
	Dynamic Pricing		Next day hourly pricing available for domestic and commercial customers.
Connectivity			Was already good in 2017. 89% of households have fibre.
Demand Response			Seeing more demand response in the electrical contracts. BD have been negotiating with energy companies to get kickback for reducing loads.
Building Energy Storage			Using phase shifting materials, investigating hydrogen storage (government funding the project).
Electric Vehicles			Volvo going 100% electric/hybrid. Tax break for electric cars.
Efficient Heating Capacity	**District Heating**		No increase in the last 3 years.
	Heat Pumps		Being used to provide load balancing with the district heating (borehole thermal storage, being used in almost every project, giving free heating when available).
Renewable Energy			Top marks in 2017. More wind turbines than in 2017, especially in the south.
Photovoltaics			Booming in residential. Government grant of 30% on investment. Commercial buildings are using more as part of the developers sustainability program.
Smart Readiness			Slow improvement

Figure 6. Sweden smart readiness indicator improvement 2017-2020

In 2017 Sweden was in position 1 out of 28 countries, based on the BPIE Smart Building Readiness index. Based on the 2020 interview there has been:

Fast improvement in one area:

1. Healthy Living and Working Environment. WELL certification is becoming more popular. In contracts and tendering documents there are more references to healthy living and environment. New regulations also refer to this.

Steady improvement in two areas:

1. Dynamic Pricing. Next day hourly pricing is available for domestic and commercial customers.
2. Photovoltaics. Booming in residential. Government grant of 30% on investment. Commercial buildings are using more PVs as part of the developers' sustainability program.

Sweden has made a slow improvement since 2017 and has a score of 17 (see Fig. 14) but was top of the table in 2017.

Market Overview & Trends

- 80 % of the buildings that are part of the 2050 climate-neutral target have already been built. So, there is focus on the existing buildings and making them more efficient.
    - Existing building market regulations have been renewed to address this. E.g. BREEAM in Use.
- WELL certification is starting to be used more in Sweden. It was becoming more popular before COVID-19 but a higher awareness of health in buildings could be a product of COVID-19.
- Partnering contracts are becoming more popular. These are turnkey contracts and profit is regulated by how well you deliver. There is a high level of collaboration between contractor, architect, designer and it is an open book contract. In these contracts agile processes are being used more, e.g. stand up meetings instead of long meetings with many participants.
    - This type of partnering contract has been done for approximately 10 years and mistakes have been made in the past but now lessons have been learnt.
- Other key trends in the next five years are likely to be:
    - Digitalisation. IOT Sensors and monitoring, newcomers are challenging the building automation business with an alternative to BMS.
    - More automated design, parametric design, AI Digital processes for repetitive design.
    - Simulation of buildings, Sun, energy, CO2 in predesign, effect of different material.
    - Visualisation of building technology.
    - Agile processes to reduce unnecessary work, more efficient building process.
- Some new business models appearing.
    - New business and organisational models have proved successful for some companies. Flat organisations and a focus on employee satisfaction have moved the focus from maximizing profit to long term relations and a more effective use of resources. There are even examples of some companies paying back an overachieved margin on projects, to be rewarded with multi-year commitments in return. Self-managing, with a focus on purpose instead of profit seems to work well in Sweden.
    - How can we change the design/consultancy business model?
    - Construction companies say they would agree to pay a fixed price if the designer would take more risk. This may be a change in the business model in the future.

Challenges

- Do we know our user / customer needs? We deliver against a tender document but should understand their basic needs more.
- In the future there needs to be a more innovative approach and we need to be agile. This business will not be the same in 15 years. We do not know what the tech companies will finally decide to do with the market and their offers.
- In Sweden there are 2 types of contract.
    - General: Developer has all the power and risk. Contracts are with the developer. Architects also have a lot of power. Designers can have more influence in a general contract.
    - Total: Developer goes to construction company and agrees a turnkey contract. Construction company has the power. Cheap CAPEX. Build as fast and cheap as possible.
    - The Government could help more by changing contract types, for example there is no standard contract for partnership contracts.
- More investment in innovation is needed. Bengt Dahlgren invested 1,9% in 2019 but the construction industry investment is only about 1%.

4.5. Spain

The interview was carried out with Juan Gallostra (President) and Gil Vinyeta (Industrial Engineer) with JG Ingenieros.

JG Ingenieros offers Building Services design and consultancy services ranging from the initial conceptual phase of a project to its building process and management, as well as quality controls, test validations, commissioning and post-construction services: including maintenance engineering and continued technical assistance.

JG Ingenieros' main segments are hospitals, offices, retail and cultural buildings and has offices in Spain, Morocco, Peru and Panama.

There are around 160 employees and the predicted turnover for 2020 is approximately 10M€.

Figure 7. Spain smart readiness indicator improvement 2017-2020

In 2017 Spain was in position 12 out of 28 countries, based on the BPIE Smart Building Readiness index. Based on the 2020 interview there has been:

Fast improvement in four areas:

1. Building Envelope (U-value). A new national energy code has been in force since 2019 and this has also improved the building envelope.
2. Final Energy Consumption. A new national energy code has been in force since 2019.
3. Electric Vehicles. Spain's electric vehicle stock in 2017 was 19 713 and 53 847 in 2019 (statistica.com)
4. Renewable Energy. New energy code asks for 60% renewable energy in buildings.

Steady improvement in two areas:

1. Smart Meter Deployment. Spain committed to installing smart meters in 100% of homes and businesses by the end of 2018.
2. Connectivity. New fibre optic networks deployed around the country.
3. Heat Pumps. The new energy code puts a penalty on boilers.
4. Photovoltaics. Boosted by the new energy code. Cost is going down and efficiency is going up.

Spain has made a slow/steady improvement since 2017 and has a score of 23 (see Fig. 14).

Market Overview & Trends

- Generally, there is still more focus on the CAPEX at design stage and most developers have a short-term view, however there is coming more interest in OPEX, indoor environment, Health & Safety and Data.
    - PPP for hospital or prison will look at the total lifecycle cost.
- The 2019 Spanish Energy Code has had a big impact as it forces a big deployment of renewable energy in buildings.
- Green project financing for large real estate projects is available at very competitive rates. This is having a positive effect.
- One Real estate developer has developed an app for clients where the tenant can find all services available. If they own multiple buildings a tenant can use the app across the buildings. Before this there were many apps required.
- Other key trends in the next five years are likely to be:
    - More focus on sustainability.
    - COVID 19: Health and Safety design approach.
        - JGI developed guidelines during 1st wave but customers were not so interested then. Now interest is growing during the 2nd wave.
    - Greater importance of FM strategies.
        - Partly because of the increased international clients in Spain that are more demanding.

Challenges

- There is a need to break the silos, to focus more on the occupant experience and space management, sharing data across services to do this.
    - JGI have a concept in healthcare, using date from medical devices to control HVAC and lighting systems. Examples of this has been implemented in a healthcare accident room and a logistic building (using digital twin from polytechnic, for testing indoor environment and IOT sensors).
    - JGI are now working on solutions for offices.
- The market is very price sensitive. Standard designs are pushing the price down. As buildings get more sustainable and smarter this should help raise the price based on the added value.

- Traditional design business is very mature, JGI are moving to consulting services, such as FM consulting for FM tender preparation, etc., Energy, Smart, Sustainability consulting.
- The regular MEP design market has been served by mainly local companies but in the smart building market there are more international consultants, such as AECOM, Deerns, Arup…
- There isn't a specific smart building organization in Spain.
    - JGI would welcome a Smart building rating.
- There are too many building certification systems, and this is confusing for the clients. Too many certificates bring the value of the certificate down.

4.6. Lithuania

The interview was carried out with Gediminas Šilanskas, Head of Energy Efficiency with MEPCO.

MEPCO offers Mechanical Electrical and Plumbing (MEP) design services using the latest BIM software, energy consultancy services, BREEAM and WELL certification and is a representative for Granlund Manager FM software.

MEPCO's main segments are offices, government buildings, retail, hotels and apartment complexes. MEPCO has projects throughout the Baltics and some other European countries, supported from the Vilnius office.

There are around 27 employees and the predicted turnover for 2020 is approximately 1M€.

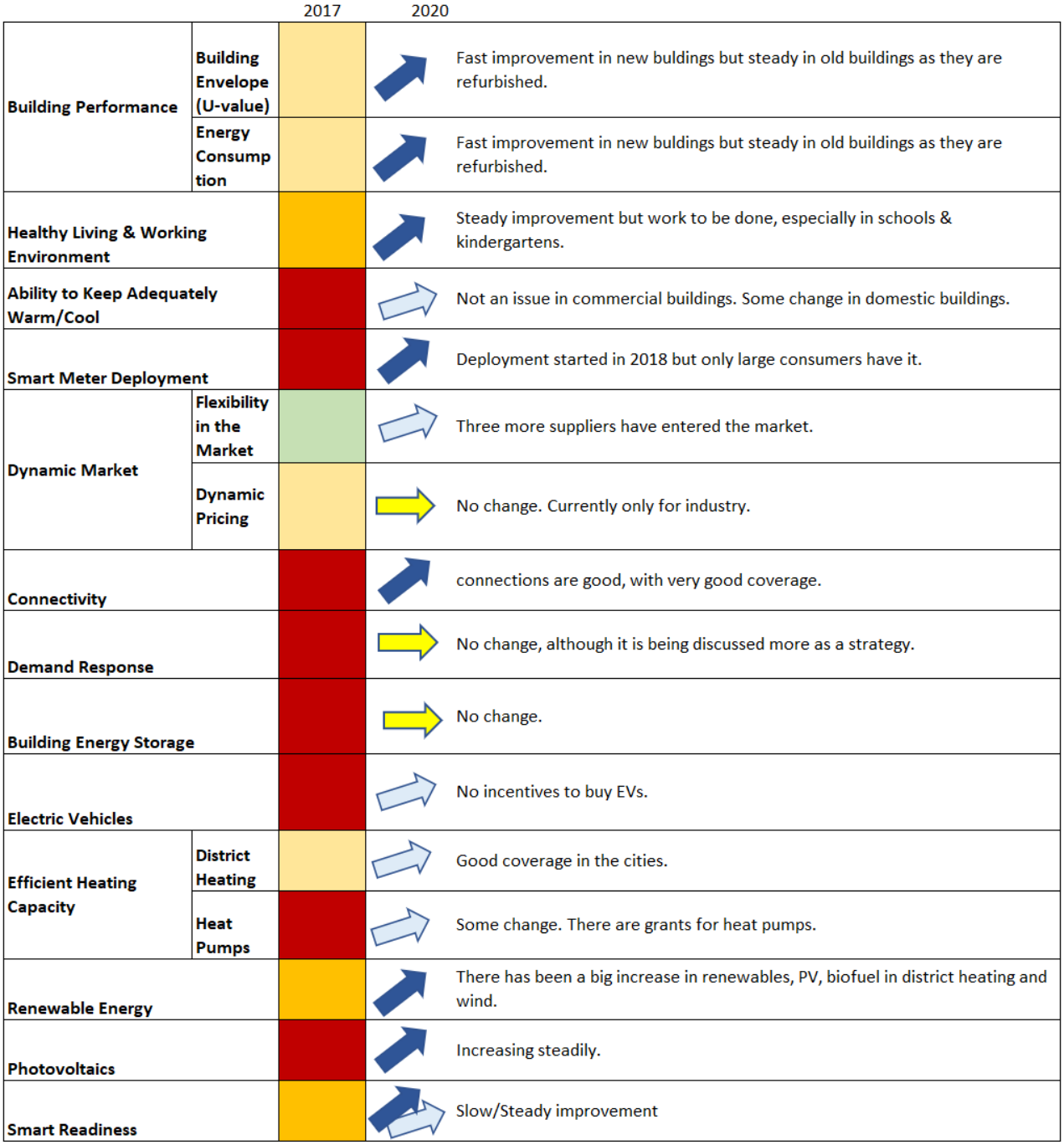

Figure 8. Lithuania smart readiness indicator improvement 2017-2020

In 2017 Lithuania was in position 22 out of 28 countries, based on the BPIE Smart Building Readiness index. Based on the 2020 interview there has been:

No fast improvement in any area but steady improvement in seven areas:

1. Building Envelope (U-value). There is a fast improvement in new buildings but steady improvement in existing buildings, happening as they are refurbished.
2. Final Energy Consumption. Same comment as above.
3. Healthy Living and Working Environment. Steady improvement but work to be done, especially in schools and kindergartens.
4. Smart Meter Deployment. Started in 2018 but only large consumers have them.
5. Connectivity. Connections are good, with very good coverage.
6. Renewable energy. There has been a big increase in renewables, especially PVs, biofuel in district heating and wind.
7. Photovoltaics. Increasing steadily.

Lithuania has made a slow/steady improvement since 2017 and has a score of 19 (see Fig. 14).

Market Overview & Trends

- In Lithuania there is still a lot of work to be done to improve the energy efficiency of the buildings and this is the main focus.
    - Many of the existing buildings do not have sufficient indoor monitoring so MEPCO are Using IOT "Connected Inventions" sigfox devices to monitor indoor quality and make energy savings that do not impact air quality.
- New buildings are commonly having LEED or BREEAM certification and there is more concern about reduced OPEX.
- More smart meters are being installed and using connected meters to split building load monitoring.
- The minimum energy performance class of new buildings has been progressively tightened since 2016. This is forcing developers to search for more efficient solutions at design phase.

Challenges

- The existing building stock is steadily being renovated but it will take time.
- Poor facility maintenance is the main reason for wasting energy.

4.7. Germany

The interview was carried out with Bruno Lupulesco, Group Leader Building Automation with ZWP Ingenieur-AG.

ZWP Ingenieur-AG specializes especially in the areas of planning and consultancy technical building services, energy design, certified sustainability, simulation, building physics, lighting design, laboratory planning, technical and economic controlling, integrated planning, BIM (building information modelling), commissioning management and monitoring.

ZWP Ingenieur-AG's main segments are Office, Hospitals, Labs, Production, Education, Stadium/sports arena, Retail, Hotel, Residential, Museums, Supermarkets, Data centres.

There are around 400-450 employees and the predicted turnover for 2020 is approximately 34,5M€.

		2017	2020	
Building Performance	**Building Envelope (U-value)**		↗	Legislation has been updated and there is a focus on the envelope.
	Energy Consumption		→	Focus has been on heating efficiency but now the summers are warmer and cooling is being used more.
Healthy Living & Working Environment			→	WELL Certification is more in demand.
Ability to Keep Adequately Warm/Cool			↘	More issues with cooling now. Public buildings cannot have mechanical cooling (without very good reasons, such as laboratories). Heating is not a problem.
Smart Meter Deployment			↗	There was a boom in PVs as there is a premium for feeding back to the grid. This fuelled smart meters.
Dynamic Market	**Flexibility in the Market**		→	Not much change but it was good already three years ago.
	Dynamic Pricing		↗	Available for commercial and domestic customers.
Connectivity			→	Fast internet is not available even in some cities due to an old infrastructure. Mobile has improved as the infra has improved.
Demand Response			→	Available for large customers.
Building Energy Storage			↗	Some thermal storage but not electrical.
Electric Vehicles			→	Company car tax is half the cost if it is a hybrid or electric.
Efficient Heating Capacity	**District Heating**		→	No new infra in last 3 years but already quite established.
	Heat Pumps		↗	Especially in residential as there are subsidies but also for commercial.
Renewable Energy			↗	Steady YOY increase in electricity generation from renewables.
Photovoltaics			→	There was a boom over 3 years ago although they are still used in some new builds with a large roof area.
Smart Readiness			→	Slow improvement

Figure 9. Germany smart readiness indicator improvement 2017-2020

In 2017 Germany was in position 8 out of 28 countries, based on the BPIE Smart Building Readiness index. Based on the 2020 interview:

There is no fast improvement in any area but steady improvement in six areas:

1. Building Envelope (U-value). Legislation has been updated and there is a focus on the building envelope.
2. Smart Meter Deployment. There was a boom in PVs as there is a premium paid for feeding back to the grid. This fuelled smart meters.
3. Dynamic Pricing. Available for commercial and domestic customers.
4. Building Energy Storage. Increase in thermal storage but not electrical.
5. Heat Pumps. Especially in residential as there are subsidies but also for commercial.
6. Renewable Energy. Steady YOY increase in electricity generation from renewables.

Germany has made a slow improvement since 2017 and has a score of 15 (see Fig. 14).

Market Overview & Trends

- Market entry barrier is quite low in Germany (for small projects). Smaller projects are very price sensitive.
- Larger projects need good references and quality is important. Also, the ability to deliver and be strong with the construction companies is key as they can be aggressive in Germany.
- ZWP is involved in a new type "Integrated project delivery". This is an open book contract project where all stakeholders are working together. It is quite a new thing in Germany, where the builders are traditionally quite aggressive.
    - If budget is improved there is a bonus based on the input.
    - Project has been ongoing for a year and positive so far.
- If real estate developer is building without a tenant, it is cost driven. Not much focus on the OPEX as these are paid by the tenants. It can be more OPEX focused if there is a tenant.
- In production projects the Maintenance & Operation is a very high priority.
- New public buildings have compulsory remote monitoring for energy. Each state has own public construction rules. Southern states focus more on this policy.
- EU Taxonomy related to building portfolios. It is not clear the impact this will have on sustainable buildings.
- Other key trends in the next five years are likely to be:
    - Edge (OVG Real Estate, developed The Edge) are building 7 buildings in Germany.
    - Germans are conservative with personal security and use of data so the people monitoring aspect is proving an issue.
- Some Heating as a Service type contracts (often offshoots of utility companies) are appearing. 15-20-year contracts based on a KWH rate, without CAPEX.
    - The building developer does not invest in a heating system. The Heating as a Service supplier will install the heating system and charge a KWH rate based on a 15-20-year agreement.

Challenges

- Some established BMS players, are more focused on continued selling of controllers and maintenance contracts. Not willing to develop their cloud services (in Germany).
    - Tech startups are starting to do this and are frustrated that the established companies are not sharing their data.
- For the building tenant there is a lack of transparency as to how the building works. There is a silo between the builder and the tenant.
    - It is best for the tenant to be involved as early as possible, but the builder does not always see this is in their interest as the tenant often wants more features.

4.8. Switzerland

The interview was carried out with Marco Waldhauser, CEO with Waldhauser + Hermann AG.

Waldhauser + Hermann AG offers HVAC design & consulting, Energy concepts, Energy optimization, Energy, sustainability and FM consulting.

"We think holistically, dispense with technology where possible and sensible and advocate a good indoor climate without air conditioning."

There are around 51 employees and the predicted turnover for 2020 is approximately 7,5M€.

		2017	2020	
Building Performance	**Building Envelope (U-value)**		↗	There has especially been a focus on glass envelopes recently.
	Energy Consumption		→	This has been pushed hard to minimise for the last 20 years.
Healthy Living & Working Environment			→	Not such a big issue but workplace improvement is happening.
Ability to Keep Adequately Warm/Cool			→	Part of our normal business. W&H focus on natural cooling but it is not a general trend.
Smart Meter Deployment			↑	Fast improvement and there are innovative solutions.
Dynamic Market	**Flexibility in the Market**		→	Slow improvement.
	Dynamic Pricing		→	No change.
Connectivity			↗	Steady improvement.
Demand Response			→	Haven't seen it in use.
Building Energy Storage			→	Fields of heat pumps utilising Borehole Thermal Energy Storage and intelligent energy management.
Electric Vehicles			↑	Fast increase in new sales since 2017.
Efficient Heating Capacity	**District Heating**		↗	Very popular in cities. 100% renewable.
	Heat Pumps		↗	Direct electrical heating was banned years ago.
Renewable Energy			↗	Was already on a high standard.
Photovoltaics			↑	Prices going down, nice possibilities for façade integrations
Smart Readiness			↗	Slow/Steady improvement

Figure 10. Switzerland smart readiness indicator improvement 2017-2020

As Switzerland is not part of the EU it was not assessed by the BPIE in 2017. However, based on the 2020 interview the findings are:

Fast improvement in three areas:

1. Smart Meter Deployment. There has been a fast improvement. Swiss Energy Law requires 80% of measuring devices in the electrical grid must be exchanged with smart meters by the end of 2027.
2. Electric Vehicles. Fast increase in new sales since 2017.
3. Photovoltaics. Cost is going down. Nice possibilities for façade integrations.

Steady improvement in five areas:

1. Building Envelope (U-value). There has especially been a focus on glass envelopes recently.
2. Connectivity. Steady improvement.
3. District Heating. Popular in cities. 100% renewable and recycled heat.
4. Heat Pumps. Direct electrical heating was banned some years ago.
5. Renewable Energy. In 2019 75% of consumption came from renewable energy.

Switzerland has made a slow/steady improvement since 2017 and has a score of 25 (see Fig. 14).

Market Overview & Trends

- Waldhauser + Hermann AG are focussing on optimising digital design and processes throughout the building lifecycle.
- Waldhauser + Hermann AG are expanding into BMS and FM consulting, as well as strengthening their consulting services for new and existing building owners.
- Historically W&H is known as the engineering company that comes up with new ideas and looking to build with as little tech as possible (this is not typical in Switzerland and so is a differentiator).
    - "Frustrations starts, when the usage of the building is not given as expected. Often, climatic conditions can cause these frustrations. Too complex building automation systems and no end users who would understand the "how to" of the building. We therefore try to keep it simple and smart"
- All stakeholders want quality, sustainability, simple technic and understandable systems.
- In past, designers have driven the digitization changes in the industry. Now customers are demanding it.
- Building design business is a quite stable at the moment most companies are constantly overbooked.
- Other key trends in the next five years are likely to be:
    - Digitization
    - It is to be seen if large BMS companies will have the edge or the big tech companies.
    - In small buildings tech / cloud solutions could take over.

Challenges

- The benefit in energy cost saving is unfortunately too small, as energy is quite cheap. That's the main reason why there is more to be done in this area, although larger companies use nice energy concepts for branding and marketing of the own company.
    - Switzerland has some strong energy regulations, which help with this.

4.9. Italy

The interview was carried out with Giorgio Molinari, Systems Designer with Manens-Tifs s.p.a..

Manens-Tifs is a consulting company, specialised in the field of engineering and project management for the building sector with special focus on MEP Design, Sustainability Services (Pre-assessment, LEED-WELL-BREEAM certification services), BIM services

Manens-Tifs is operating in Italy and The Kingdom of Saudi Arabia (KSA). Their main segments are Hospitals, Office Buildings, High-rise office buildings, Shopping Centres.

There are around 175 employees in Italy and 350 in KSA. The predicted turnover for 2020 is approximately 38M€.

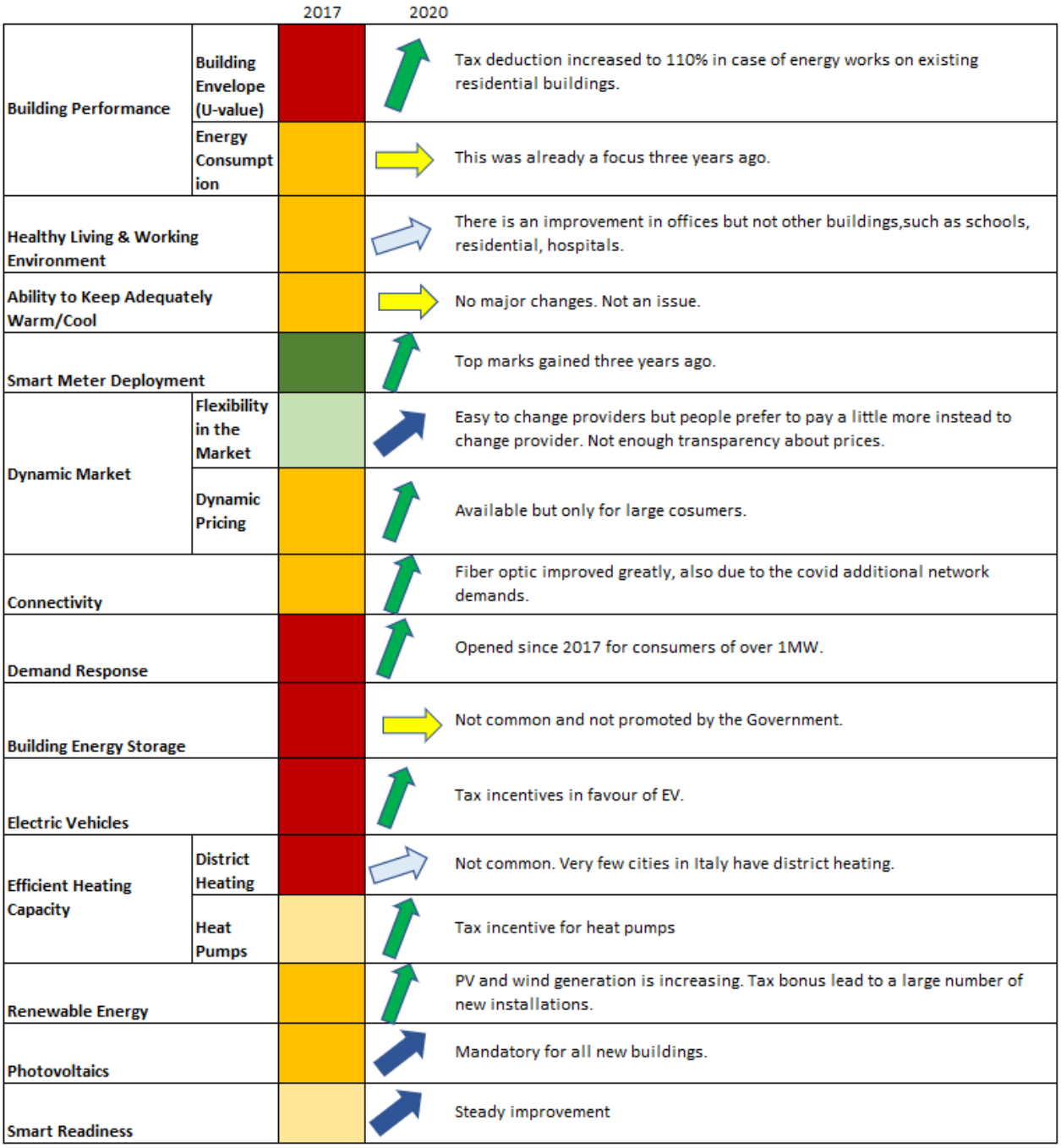

Figure 11. Italy smart readiness indicator improvement 2017-2020

In 2017 Italy was in position 11 out of 28 countries, based on the BPIE Smart Building Readiness index. Based on the 2020 interview there is:

Fast improvement in eight areas:

1. Building Envelope (U-value). Tax deduction increased to 110% in case of energy works on existing residential buildings.
2. Smart Meter Deployment. Top marks already gained three years ago.
3. Dynamic Pricing. Available but only for large consumers.
4. Connectivity. Fibre optic improved greatly, also due to the COVID-19 additional network demands.
5. Demand Response. Opened since 2017 for consumers of over 1MW.
6. Electric Vehicles. Tax incentives in favour of EVs.
7. Heat Pumps. Tax incentive for installing heat pumps.
8. Renewable Energy. PV and wind generation is increasing. Tax incentives lead to a large number of new installations.

Steady improvement in two areas:

1. Flexibility in the Market. Easy to change providers but people are prepared to pay a little more instead of changing provider. Not enough transparency about prices.
2. Photovoltaics. Now mandatory on all new buildings.

Italy has made a steady improvement since 2017 and has a score of 30 (see Fig. 14).

Market Overview & Trends

- The way of doing business can be complicated and there is not enough continuity due to the silos between the design and operations team in a construction project.
- Italy is a price sensitive market and can be difficult to get adequate fees for the service offered.
- WELL certification is growing. HR managers are focusing on offering a better environment for employees instead of salary increases. This is the main reason for the growth in Italy.
- The most high-profile high-rise office buildings in Italy have been designed by Manens Tifs. They have a great deal of experience in high rise buildings.
- Since 2017 in Italy the energy demand market has opened to demand response for large consumers. They also sell back PV energy to the grid. This can be a good business and some shopping centres are doing this, as well as using the PV generated electricity for EV charging.
- The Smart Building Alliance is launching in Italy in December. This should raise the profile of smart buildings even more.
- Until now the Government has played an important role as it acts as a steering committee. Tax – incentives are used to address construction industries, but these are usually for energy related initiatives and not specifically smart building initiatives.
- Other key trends in the next five years are likely to be:
    - An increase in number of Smart Buildings is expected and the interest from developers is already increasing.
    - Wide adoption of BIM methodology in the design and construction process
- The design team needs to continuously update their skills as a result of these trends.

Challenges

- Despite more interest in OPEX still most developers want to keep CAPEX as low as possible.
- Newcomers can be rule-breakers. They have young management, and a comprehensive engagement of the workforce.

4.10. The Netherlands

The interview was carried out with Steven Mast, General Manager with Smits Van Burgst.

Smits Van Burgst is a building services design and consulting company, specialized in MEP, fire safety, security and BREEAM certification.

Their main segments are Offices, Logistics and Data centres.

There are around 55 employees (+25 sub-contractors) and the predicted turnover for 2020 is approximately 7,6M€.

		2017	2020	
Building Performance	**Building Envelope (U-value)**		↗	Energy Performance of Buildings Directive (EPBD) is driving steady progress
	Energy Consumption		↗	Government still pushing efficient use of energy hard. This is needed as the energy bills are being paid by the tenant and not the developers. Without the legislation they do not always have the incentive.
Healthy Living & Working Environment			↑	Big focus this year, WELL has been increasing in use and now covid has accelerated the progress and increased the focus on the indoor environment.
Ability to Keep Adequately Warm/Cool			→	No major changes. Not an issue.
Smart Meter Deployment			↗	Every home has a smart meter, EMS in the commercial buildings are slow in uptake.
Dynamic Market	**Flexibility in the Market**		↗	Easy to change suppliers.
	Dynamic Pricing		→	Energy bills low compared to salary costs, so it is not being optimised as the time is better spent improving productivity. Dynamic pricing is available.
Connectivity			→	Cheap and fast connections available to everyone. It was already good 3 years ago.
Demand Response			→	Not happening a lot. Peak shaving used to reduce overall peak load but not in a dynamic way.
Building Energy Storage			→	Ground source heat exchangers being used on larger buildings above 20000m2. Heat pumps below that. No battery storage
Electric Vehicles			↑	9194 electric cars sold in 2017, 67318 in 2019
Efficient Heating Capacity	**District Heating**		→	Being considered in Rotterdam, for example. Geothermal installations are planned but in the development stage.
	Heat Pumps		↗	Heat pumps are a standard now. There is a move away from gas heating in commercial and domestic buildings.
Renewable Energy			→	More wind farms are being constructed but In 2019, the Netherlands produced just 8.6% of its total energy from renewables.
Photovoltaics			↗	Building regulations require photovoltaics on almost every new build and major renovation.
Smart Readiness			↗	Slow/Steady improvement

Figure 12. The Netherlands smart readiness indicator improvement 2017-2020

In 2017 The Netherlands was in position 4 out of 28 countries, based on the BPIE Smart Building Readiness index.

Based on the 2020 interview there is:

Fast improvement in two areas:

1. Healthy Living and Working Environment. There has been a big focus this year. WELL certification has been increasing in use and now COVID-19 has accelerated the progress and increased the focus on the indoor environment.
2. Electric Vehicles. 9194 electric cars sold in 2017, 67318 in 2019 (statistica.com)

Steady improvement in six areas:

1. Building Envelope (U-value). Energy Performance of Buildings Directive (EPBD) is driving steady progress
2. Energy Consumption. Government still pushing efficient use of energy hard. This is needed as the energy bills are being paid by the tenant and not the developers. Without the legislation the developers do not always have the incentive.
3. Smart Meter Deployment. Every home has a smart meter, Energy Monitoring Systems in commercial buildings is slow in uptake.
4. Flexibility in the Market. It is easy to change providers.
5. Heat Pumps. Heat pumps are a standard now. There is a move away from gas heating in commercial and domestic buildings.
6. Photovoltaics. Building regulations require photovoltaics on almost every new build and major renovation.

The Netherlands has made a slow/steady improvement since 2017 and has a score of 24 (see Fig. 14).

Market Overview & Trends

- Reduction of building emissions is an ongoing priority. All office buildings in Netherlands need an energy C label by 2023. This will create a lot of work in the next few years as building owners prepare for this. In 2018 it was reported that 50% of buildings are not ready.
- Smits Van Burgst are aiming to get more into the data side of buildings.
    - Not actively involved with companies that are providing the smart concepts but want to have the blueprints available to do this. What does a smart building really mean? It is not clear at the moment.
- Some developers e.g. Edge (OVG Real Estate, developed The Edge) are very focused on smart buildings, but not all.
    - Edge are driving interest in smart buildings due the size of the buildings they are developing and the marketing it creates. Buildings like The Edge have a lot of press and case studies.
- Smart Building Alliance is active, but they are not the ones implementing smart buildings and still rely on developers to drive the change.
- Other key trends in the next five years are likely to be:
    - Energy efficiency will be a major focus to 2030 and beyond.
    - Users being able to influence their work area.
    - Health & safety, Post COVID-19 air filters on the office floor, more fresh air changes,
    - Ensuring comfort.
    - Netherlands is seeing an increase in WELL certification
    - Smart technologies will develop to a tipping point in the next 5-10 years.
    - Smaller tech companies providing data innovations in the next 5 years and then big tech companies after that.

- Companies are developing smart concepts.

Challenges

- When discussing smart buildings no one knows what it means. The perception of what a smart building is can vary a lot between developers and other stakeholders. There needs to be clarity.
- Employers want to give their employees a good place to work but they need help with this.

4.11. France

The interview was carried out with Laurent Bernard, Technical Director and Damien Carlier, Rennes Branch Director, from Barbanel.

Barbanel is one of the leading MEP design and consultancy, specialising in digital simulation, energy efficiency and BREEAM and LEED certification. Barbanel is part of the Smart Building Alliance and co-designer for the new Ready 2 Services French label for Smart Building. Barbanel has also 12 WiredScore APs.

Their main segments are Offices 500m2 – 300 000 m2, High rise MEP design and lifts, Supermarkets, Hospitality, Data Centres, High schools

There are around 110-115 employees and the predicted turnover for 2020 is approximately 16M€.

		2017	2020	
Building Performance	Building Envelope (U-value)		↑	Regulations have been forcing this since 2012. Building 2020 regulations being released in 2021
	Final Energy Consumpti		↑	Regulations have been forcing this since 2012. Building 2020 regulations being released in 2021
Healthy Living & Working Environment			↑	This has been a market focus. Osmoz certification (similar to WELL) is popular.
Ability to Keep Adequately Warm/Cool			→	No major changes. Not an issue.
Smart Meter Deployment			↑	Fast improvement in commercial and domestic buildings.
Dynamic Market	Flexibility in the Market		↑	Easy to change supplier, but not commercially interesting due to the cheap electric.
	Dynamic Pricing		→	Dynamic pricing is available to large consumers.
Connectivity			↑	Historically the network is good, and a big development of fibre optics is ongoing.
Demand Response			→	It was good 3 years ago. Not many Aggregator companies.
Building Energy Storage			→	Some hydrogen technologies and batteries being used.
Electric Vehicles			↑	Good development of infrastructure. There is a new regulation to implement chargers in car parks.
Efficient Heating Capacity	District Heating		→	Some regions have district heating but not many.
	Heat Pumps		↑	Approx. 20% of projects are using heat pumps
Renewable Energy			→	Impact likely to be greater in the next 5 years.
Photovoltaics			→	Not commercially very beneficial but used when customer wants. Used more in the south.
Smart Readiness			↑	Slow/Steady improvement

Figure 13. France smart readiness indicator improvement 2017-2020

In 2017 France was in position 9 out of 28 countries, based on the BPIE Smart Building Readiness index. Based on the 2020 interview there is:

Fast improvement in five areas:

1. Building Envelope (U-value). Regulations have been forcing this since 2005. New building 2020 regulations are being released in 2021.
2. Energy Consumption. Regulations have been forcing this since 2012. New building 2020 regulations are being released in 2021 and a new regulation about BMS (décret tertiaire & BACS) is being applied in 2021
3. Smart Meter Deployment. Fast improvement in commercial and domestic buildings.
4. Connectivity. Historically the network is good, and a big development of fibre optics is ongoing.
5. Electric Vehicles. Good development of infrastructure. There is a new regulation to implement chargers in car parks.

Steady improvement in three areas:

1. Healthy Living and Working Environment. This had been a market focus. Osmoz certification (similar to WELL) is popular.
2. Flexibility in the Market. It is easy to change supplier, but not financially interesting due to the cheap electric costs.
3. Heat Pumps. Heat pumps are a standard now. Approx. 20% of projects are using heat pumps

France has made a slow/steady improvement since 2017 and has a score of 26 (see Fig. 14).

Market Overview & Trends

- France is a price sensitive market but Barbanel are specialized and most contracts are negotiated.
    - There are a lot of large engineering companies, but they are not providing the same detail of service as Barbanel.
- Smart Building Alliance was created in France and now SBA want to export this model.
    - There are planned openings in Luxemburg, Belgium, Switzerland and Italy and discussions in many more countries.
    - The goal is to give Guidelines to design and construct and give levels of smartness.
    - Developers are looking to achieve the certification in France (label R2S and 4Grids).
- Air quality and quality of life is important. There is much more focus on wellness.
- Increase in Osmoz certification (similar to WELL). WELL projects exist in Paris but mostly Osmoz in other regions.
- Companies dealing with IOT, smart, API integrations are successful at this time. They are listening to their customers.
- Other key trends in the next five years are likely to be:
    - Users have smart phones and buildings need to be linked to the users. They want to know how the building is working and how to interface with it. This is changing how we design the building.
    - Energy efficiency continues.
    - Flexibility, co-living and co-working.
    - Some small startups being very agile can drive the market. Could be bought by the large companies in the coming years.
- Energy low carbon technologies are being considered now but will be more in demand after the new regulations in 2021. Energy is quite cheap in France.

Challenges

- Customers want a building that is smart for the next 10-15 years. They do not know how to build due to changing tenant needs, co-working, services.
    - Needs to be a strong design with maximum flexibility, while maintaining efficiency/cost.

5. Progress Since 2017

		Italy	France	Switzerland	The Netherlands	Belgium	Spain	Lithuania	Sweden	Ireland	Finland	Germany	Indicator Improvement Value	Indicator Improvement Placing
	2017 position	11th	9th	N/A	4th	23rd	12th	22nd	1st	10th	2nd	8th		
Building Performance	Building Envelope (U-value)	3	3	2	2	1	3	2	1	0	0	2	19	5
	Final Energy Consumption	0	3	1	2	2	3	2	1	2	1	1	18	6
Ability to Keep Adequately Warm/Cool		0	0	1	1	0	0	1	1	0	1	-1	4	12
Smart Meter Deployment		3	3	3	2	2	2	2	0	1	1	2	21	3
Dynamic Market	Flexibility in the Market	2	2	1	2	1	1	1	1	0	1	0	12	8
	Dynamic Pricing	3	1	0	1	1	1	0	2	0	2	2	13	7
Connectivity		3	2	3	1	2	2	2	1	1	1	0	18	6
Demand Response		3	1	0	0	1	0	0	1	0	1	0	7	11
Building Energy Storage		0	1	1	1	1	0	0	1	1	0	2	8	10
Electric Vehicles		3	3	3	3	2	3	1	1	2	2	1	24	1
Efficient Heating Capacity	District Heating	1	1	2	1	3	0	1	0	1	0	0	10	9
	Heat Pumps	3	2	2	2	3	2	1	1	1	3	2	22	2
Renewable Energy		3	1	2	1	1	3	2	1	2	1	2	19	5
Photovoltaics		2	1	3	2	2	2	2	2	2	1	1	20	4
Country Improvement Value		30	26	25	24	24	23	19	17	16	15	15		

Fast improvement: 3 points. Steady improvement: 2 points. Slow improvement: 1 point. No change: 0 points. Decline: -1 point

Figure 14. Improvement in the indicators 2017-2020

Following the interviews, a score was given to each of the indicators based upon how fast the change has been since 2017.

The Country Improvement Value shows the total number of points each country has been awarded and the countries have been arranged in order of improvement. Italy has improved the most, scoring 30 points and with Germany and Finland not improving so much, both scoring 15 points.

It could be expected that those countries that already obtained high results in 2017 would not improve so much in the last three years and those scoring lower in 2017 have caught up in the last three years. There are some exceptions though, such as The Netherlands which was in 4th place in 2017 and still scored 24 points. It could be expected that Germany and Ireland would have also scored more in the last three years, but as we discuss later the indicators used by the BPEI do not show the whole smart building picture.

On the right hand of the graph you can see the improvement rating of each indicator and the placing. This gives us an idea of the most popular trends in Europe now.

1st- Electric vehicles	24 points	6th- Connectivity	18 points
2nd- Heat pumps	22 points	7th- Dynamic pricing	13 points
3rd- Smart Meter Deployment	21 points	8th- Flexibility in the market	12 points
4th- Photovoltaics	20 points	9th- District heating	10 points
5th- Renewable energy	19 points	10th- Building energy storage	8 points
5th- Building envelope (U-value)	19 points	11th- Demand response	7 points
6th- Final energy consumption	18 points	12th- Ability to keep warm/cool	4 points

Electric vehicles are the most improved indicator, which is very positive, but one concept is that the battery of the electric car is used to store locally produced electricity from PVs and then that energy is used during peak grid loads, or is fed into the grid. Despite some pilot projects this is not happening.

Heat pumps have become very popular and smart meter deployment is progressing in all countries.

Renewable energy and photovoltaics also score highly and have become the norm in many countries.

Final energy consumption continues to be a focus.

Some indicators such as Flexibility in the Market and Demand Response are available in many countries but do not seem to be commonly used. The importance of these indicators is that if used the total grid peak capacity can be reduced and balanced. Perhaps the relatively low cost of energy is not making this a priority from a cost perspective but could be more of a focus from a sustainability perspective.

Generally, figure 14 shows there is progress being made in every country and in every indicator.

6. Other Smart Building Factors

The indicators chosen by the BPIE are important, but they do not show the full picture of what is required in a smart building. The BPIE indicators are very focused on energy, metering and dynamic grid features, which help with reducing generation needs and balancing the grid.

These indicators do not address the data management challenges, integration between services, or how to use the data. These are issues that were raised by all countries during the interviews. Some of the main challenges are shown below:

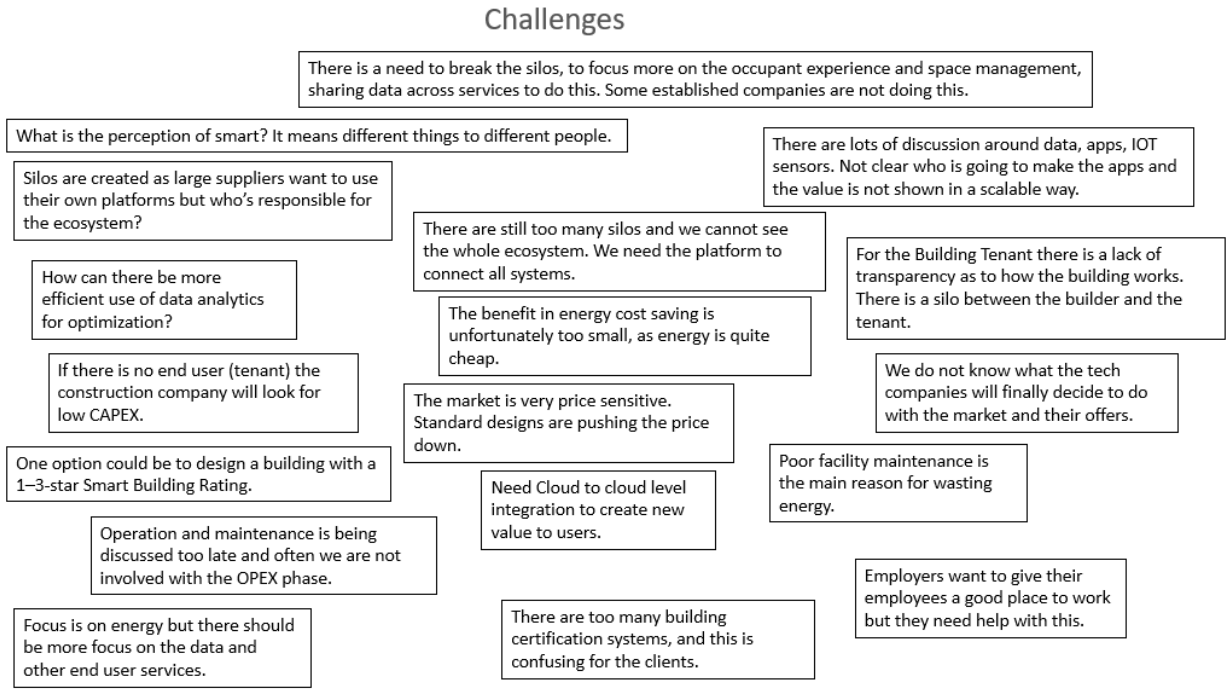

Figure 15. Main challenges highlighted during the interviews

It should be noted that there are multiple organisations currently making analysis and recommendations related to smart building readiness indicators. Three are mentioned below, but there are others.

- Smart Building Alliance – The goal is to give Guidelines for design and construction based on levels of smartness.
  - https://www.smartbuildingsalliance.org/en/home
- European Commission Smart Readiness Indicator for Buildings. Aims to further promote smart building technologies, in particular through the establishment of a Smart Readiness Indicator (SRI) for buildings.
  - https://smartreadinessindicator.eu/
- SPIRE Smart Building assessment. A comprehensive smart building assessment and rating program.
  - https://spiresmartbuildings.ul.com/

7. First Q Network Country Specific Opportunities

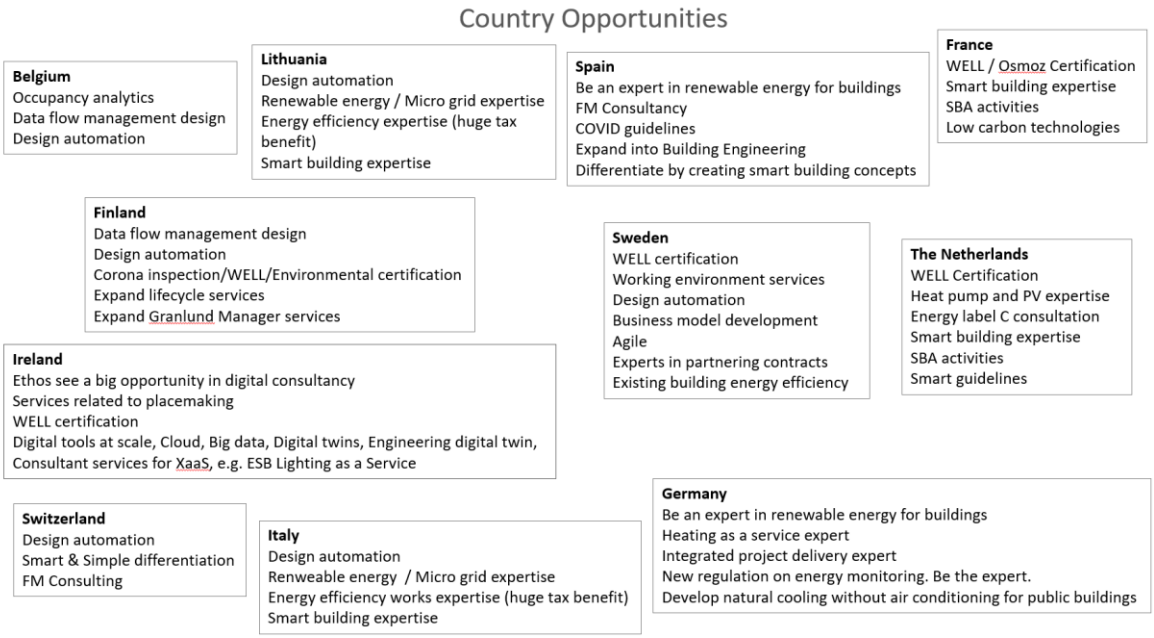

Figure 16. Country specific opportunities

During the interviews many of the opportunities in figure 16 above were mentioned as being a focus area. Others are a suggested opportunity based the trends, challenges or learnings from other countries.

For instance, Germany is having warmer summers and yet mechanical air conditioning is not permitted in most public buildings. Waldhauser + Hermann AG are specialists in non-mechanical cooling and ventilation. Could there be some co-operation?

Some people mentioned they are going into facility management. Could Granlund Manager be used as a tool?

There is a lot of focus on design automation. What co-operation or learning could be gained in this area?

8. General Opportunities

Figure 17 is a table of opportunities, some ongoing in some countries and some are a suggestion based on the trends and challenges. The benefit of this table is it can be used as a list of services that can be reviewed and assessed as being suitable for your country and business.

Opportunities	Description	Comments
Occupancy analytics	System to analyse use of working spaces and meeting rooms to maximise use of space and ensure efficiency of other systems in that space. Work culture is changing, accelerated by COVID-19. There will be a high focus on occupancy analytics in the future.	Occupancy analytics systems are available but may have a high cost. Could existing sensors be used to create a basic occupancy analytics system? Access control, security, lighting PIRs, BMS…
Data flow management design	Design a platform for smart buildings. Ensure all systems used in the building make sensors and data available for other systems to use. Make big data useful.	Could be an 3rd party solution that has been tested with the other systems in the design.
Digital consultancy	Could include digital design, BIM, Smart Building design and strategies, Digital FM, Cloud, Digital Twins…..	An area customers need help in understanding what is possible.
Design automation	Automation of repetitive design processes.	Will aid efficiency and offset price sensitivity.
COVID inspection, WELL, Environmental certification	WELL Health-Safety Rating certification was becoming popular before COVID-19 and now more so. Along with COVID-19 inspections and guidelines there is a trend to focus on the indoor environment and healthy working conditions.	WELL gaining leverage in southern Europe and UK, and expected to gain in northern Europe. Opportunities to help customers get employees back to work safely.
Office space consultancy, Placemaking	"Integrating design, amenity and community to create a unique space where people want to be." Its a growing trend linked to the health and wellbeing of people at work. Lighting, air quality, smart services all influence these spaces.	Opportunity to work with the architects, designers creating these spaces.
Expand lifecycle services/ FM consulting	Facility management consulting/services, Remote monitoring of HVAC/Energy, Energy services, Granlund Manager/software services are all ways to expand from a design and consultancy business to a lifecycle services business.	As facility management processes improve and there is more focus on OPEX providing services throughout the lifecycle of the building are one way to expand the business.
X as a Service	Energy as a Service, Lighting as a Service, Heating as a Service, Space as a Service, Remote Monitoring as a Service. Theses are all business models that create opportunities to either provide the service or design and consult for the companies providing the service.	Any company providing these services wants to keep OPEX as low as possible, while maintaining a high quality service. Perfect opportunity to design smart and intelligent.
Renewable energy	Design and consultancy services specialising in renewable energy, especially photovoltaics and heat pumps.	Legislation and sustainability trends, decentralised power generation and the development of the dynamic energy market are all coming together to create now strong renewable energy opportunities and increased micro grid opportunities.
Micro grid expertise	Micro grid design and consultancy services.	
Energy efficiency consultancy	Continued consultancy in this area with the addition of data analytics to obtain further efficiencies.	Has been a focus for many years but new data analytics can improve efficiencies further. The majority of the buildings that will be in use in 2050 have already been built, so high focus on existing buildings.
Smart building concepts	Create a blueprint for smart buildings. Know what systems work together and help the customer to choose from this shopping list.	The First Q Smart Buildings team have already something in place.
Internal efficiencies / Agile	Agile processes to reduce unnecessary work, more efficient design and build process. Be quick to change.	The smart building industry roadmap is not clear and there could be major disruption in the future. By being agile and quick to adapt these disruptions can be opportunities.
Partnering	Some countries are seeing more partnering (alliance) contracts during construction and they are working. Partnering with other companies to provide smart solutions is also needed.	Generally, a well managed partnership brings higher gains than competition.
Smart Building Alliance and other organisations	SBA is expanding outside of France, SPIRE Smart Building Assessment is just launching, the EU Smart Readiness Indicator report was published in Sept 2020. Involvement with these organisations can help develop the business.	SBA is very comprehensive while SPIRE is just related to assessment. EU Smart Readiness Indicator could be linked to European Energy Performance of Buildings Directive in the future.
Country specific regulations	Some regulations promote renewable energies, low carbon technologies and efficiency improvements more than others.	Great opportunities for example in Spain, Sweden, France, The Netherlands and Germany.
The Recovery & Resilience Facility (recovery from coronavirus)	The Recovery and Resilience Facility (the Facility) will make €672.5 billion in loans and grants available to support reforms and investments undertaken by Member States.	Flagship areas for investments and reforms include; Power Up - Clean technologies and renewables. Renovate - Energy efficiency of buildings. https://ec.europa.eu/info/business-economy-euro/recovery-coronavirus/recovery-and-resilience-facility_en

Figure 17. General opportunities

9. Conclusion

The findings from this analysis are that all the BPIE indicators are progressing and all countries are progressing towards smarter buildings.

Regulations and tax benefits are having a positive influence in many countries and some of the requirements have been set quite high. As we move to closer to 2030 and then 2050 climate targets there is definitely going to be more focus on energy efficiency and renewable energy.

What is also clear though is that the BPIE indicators do not tell the whole smart building story. The BPIE indicators focus a lot on energy related factors but what the findings from the interviews show is that the real challenges at the moment are caused by stakeholders having different perceptions of what a smart building is, silos in the design, construction and operation stages, no agreed model for the data flow and sharing of data…..

These challenges are not likely to be solved by regulations and need the industry to find the answers. Companies like Edge are doing this, SBA is trying to expand and do this and there are many smaller tech houses and integration experts working on solutions.

Some opportunities are highlighted in this report and the hope is that they can be reviewed in detail and an analysis made as to whether they could be implemented in any of the First Q businesses or could a collaborative approach be taken in some cases.

10. Useful Links

- Buildings Performance Institute Europe (BPIE): http://bpie.eu/
- International WELL Building Institute: https://www.wellcertified.com/
- Smart Building Alliance: https://www.smartbuildingsalliance.org/en/home
- EU Smart Readiness Indicator for Buildings: https://smartreadinessindicator.eu/
- SPIRE Smart Building assessment: https://spiresmartbuildings.ul.com/
- EU. The Recovery and Resilience Facility: https://ec.europa.eu/info/business-economy-euro/recovery-coronavirus/recovery-and-resilience-facility_en


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