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List of Definitions & Abbreviations

Abbreviation	Definition
AEC	Architect, engineer, construction
ROI	Return on Investment
BIM	Building Information Modelling
CAGR	
IFC	Industry Foundation Classes
PESTEL	Political, Economic, Socio, Technological, Environmental, Legal, Analysis
SWOT	Strengths, Weakness, Opportunity, Threats, Analysis

Task outline

This document is D3.4 Analysis of Regulations & Markets for BIM-based Renovation-support Tools

This task is responsible for analysing the regulatory and market conditions within which the BIMERR tools will be called upon to make an impact. EU and national regulations are effectively boundary conditions that must be respected by the tools (e.g. the use of only locally certified components/materials or façade modification restrictions). Prevailing legal and regulatory frameworks can place significant limitations on the freedom of renovation planners to explore available options and utilise existing technologies. The same applies for availability, cost and vendor support of solutions/components due to the particularities of national/regional circumstances. The respective frameworks of several Member States will be scrutinised to provide input to the tools, especially focusing on the validation pilot sites in Poland and Spain. Market conditions and existing barriers that hamper renovation efforts should be carefully investigated to separate real limitations from potential opportunities. They may range from availability of components/materials with desired characteristics in the respective country or region, availability of skilled labour to undertake energy efficiency renovation works, renovation financing options, information gaps, lack of appropriate tools, accountability/responsibility sharing problems, design/planning inaccuracies, etc. Analysis of all aforementioned aspects is necessary in order to assess their impact on the feasibility, cost and risk factors of applying any technology, component or material on a given renovation project. Furthermore, market and competition analysis for renovation/retrofitting tools - how big is the market, what is expected retrofitting rate from the EC, what tools are needed, how big a market can they unlock, etc.- must be carried out in order to understand the future commercialisation route for the BIMERR tool set

EXECUTIVE SUMMARY

Global Building Information Modeling (BIM) Market is expected to reach \$11.7 billion by 2022, making the BIM market a lucrative and growing one for the exploitation of the Bimerr toolkit. BIM is currently being used within the renovation sector and new build sector as well as the transport sector to design infrastructure and vehicles. Enhanced data communication and coordination among various stakeholders coupled with improved construction productivity provides a leading edge to the BIM users. However, the high cost of software and a limited number of trained professionals are hindering the market growth to an extent.

BIM value proposition showed that users reported 74% positive return on overall investment, with majority of the benefit, at 69% of 100 reporting improved collective understanding of design intent. Other benefits reported were, improved overall project quality, reduced conflicts during construction, reduced changes during construction, fast client approval cycles, better cost control / predictability, and, reduced number of requests for information.

BIM has already been mandated in several EU countries and eventually each country will be obligated to use a BIM tool due to European directives, and the potential of internationalizing of the UK standard. The mandates generally cover the area of public sector buildings and a few large private projects.

As well as BIM mandates Europe has over fourteen Directives and legislation that are stimulating the use of BIM within the renovation sector. The UK has the highest standard of BIM regulation positioning the UK as industry leaders in this field, it is likely that EU government over time will adopt the UK standard of BIM implementation.

It is therefore important to increase the current rate of building renovation while, at the same time, maintaining the cost and energy required at low levels to be in line with the national energy and environmental goals. Although Bimerr is tackling the energy efficiency reduction aspect, in some countries the current legal framework does not impose BIM implementation. One of the most important political barriers is the lack of clearly defined legal framework for the required implementation of BIM in the renovation process or construction of new buildings.

Spain has the potential of 118,946 commercial property renovations making it a good market of opportunity for exploitation of the Bimerr toolkit. There is strong government support to use BIM

tools as well as funding incentives and opportunities. Spain's technological sector is much more advanced than that of Poland's and is in a better position to adopt a toolkit like Bimerr. Poland however is at early stage development of BIM solutions and the adoption rate is low, there is not enough government support to push the usage of BIM tools, and this is generally due to lack of knowledge and education. There are lower levels of financial incentive for energy renovations and it is not mandatory to use BIM tools to renovate. Poland's Government had limited success in engaging and fostering private sector demand for BIM construction projects. As for now Poland does not seem like a strong market for the exploitation of the Bimerr toolkit.

The EU renovation stands at 57% of the construction sector making it a large market for the Bimerr toolkit. Each EU country has a new renovation target highlighted in their 'National Energy Plan for 2020 – 2030. The countries with the highest targets have been stated in this report, which will have potential for exploitation for the Bimerr toolkit. Other than Germany, Italy and France which lead the way in energy renovation, are likely to be saturated with BIM tools and may not serve as a good market for exploitation.

In general, the barriers for the uptake of BIM solutions were, high up-front costs and owners reluctant to borrow funds for energy renovation purposes. Long pay-back times of retrofitting interventions, lack of confidence of the potential investors; Insufficient and instable available funding; Lack of attractive financing for homeowners with low to medium incomes who are usually not eligible for regular bank loans. Individuals are often insufficiently acquainted with the energy performance of their building (insulation and performances of equipment) and with the comfort and quality of life an energy-efficient retrofit can bring, although the degree of unfamiliarity varies between countries. The main issue remained to be lack of knowledge and education in the BIM tools. If these barriers are removed there would be an increased number of stakeholders that would be the driving force for the Bimerr tool application.

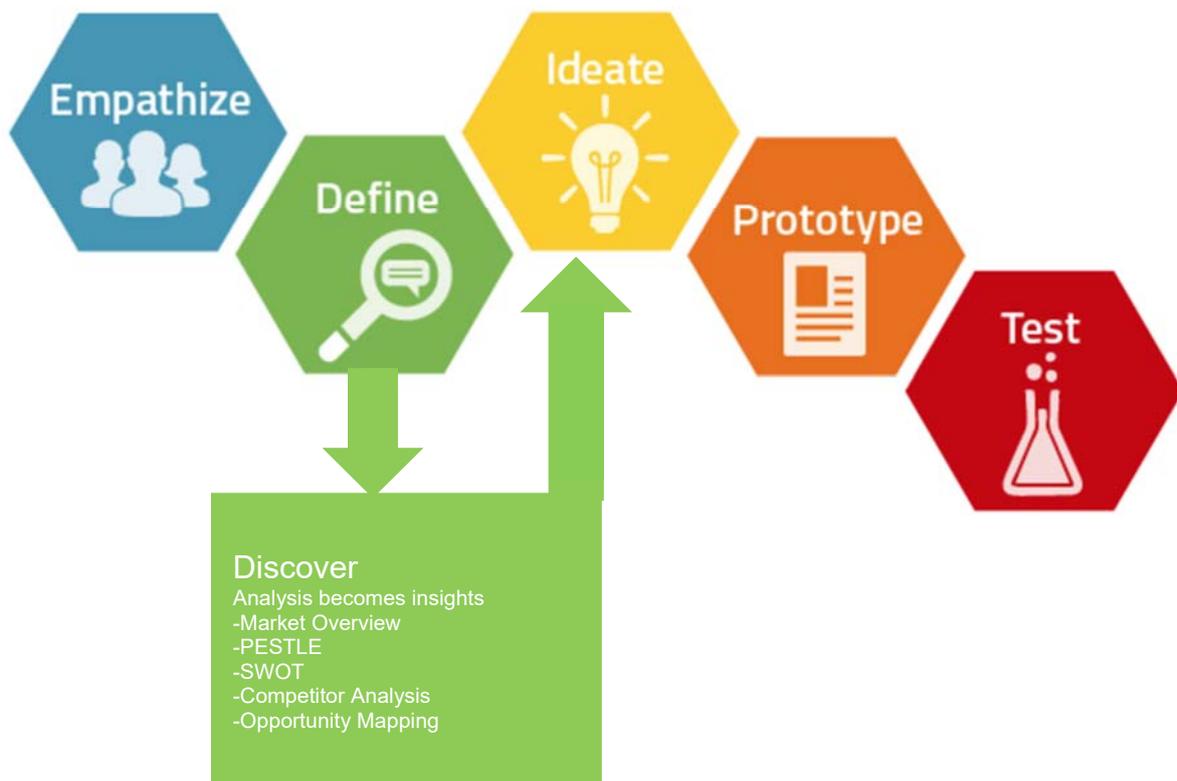
The report also found that with advancements in generative design, software algorithms, and robotic construction, the current processes will change quite a bit over the next three to ten years. It is likely there will be more and more done by computers and machines than the market has ever seen. Rather than Building Information Modeling (BIM), it is likely that we see Building Information Optimization. Rather than manually drawing walls, doors, and columns for what were good design, you would feed the computer "rules" instructing it to give us a building's optimal footprint, structural load capacity,

and thermal performance. Integration of IoT, TIC, 4.0 construction will also be further developed into BIM solutions.

Approach and methodology

The methodology to this report has been developed around Design Thinking which offers a structured framework for understanding and pursuing innovation in ways that contribute to organic growth and add real value to end-users. The design thinking cycle involves observation to discover unmet needs within the context and constraints of a particular situation, framing the opportunity and scope of innovation, generating creative ideas, testing and refining solutions.

DESIGN THINKING



1 Key Findings and Recommendations

Table 1: Key Findings

BIM Market Potential	Growing 2020 – 2023 (\$11.7 Billion by 2022)
BIM value proposition	80% of users reported a positive return on investment.
BIM mandates	26 Countries have mandated BIM use or in the process.
BIM standards	BIM is likely to internationalize UK standards worldwide.
Legal	14 Directives stimulating BIM usage in EU.
EU renovation	EU presents strong renovation requirement.
Spain	Strong market for Bimerr uptake
Poland	Weak market for Bimerr uptake, but has potential in years to come.
Heating and Cooling	Both countries requires more energy efficient cooling renovations.
SWOT analysis	Presents, strong opportunities and strengths for Bimerr toolkit in EU market
Other countries for potential exploitation of Bimerr toolkit	Croatia, Finland, Greece, Ireland, Latvia, Netherlands, Poland, Spain

Table 2: Recommendations

Recommendations

No.	Recommendation	Recommended dates
1	Reduction of cost to renovation industry where possible.	Production/ stage of commercialization.
2	Develop tool with potential to enter in new building and infrastructure market.	During development stage.
3	BIMERR toolkit should also look into the new building and infrastructure, market to commercialise the end product.	At commercialization stage
4	Advise to bench mark above competitor industry leaders' capabilities.	Throughout project
5	To provide user training as part of the package of Bimerr	On commercialization
6	Bimerr could be an add on low cost package, so companies can buy it in parts.	During development stages
7	Potential to advise regulators/ and policy makers of incorporating BIM tool into small and medium projects that are entitled to funding. Eg residential projects.	After completion

2 BIMERR Overview

2.1 BIMERR Project

Building Information Modeling (BIM), is a digital representation of a construction project, which can be used by architects, engineers, and other construction professionals. It helps in planning, designing, constructing, operating, and maintaining the diverse physical infrastructure coupled with speedy data exchange among the involved entities. Nowadays, this software tool is becoming exceptionally popular among end users owing to its lucrative advantages such as increased return on investments (ROIs), time and money saving. Rapidly increasing number of construction projects globally, rising awareness of BIM and associated benefits, and the growing demand for automated models in architecture, engineering, and construction (AEC) industry, have been facilitating its adoption in the construction industry, especially for commercial and infrastructure projects. Moreover, government mandates regarding usage of BIM in building constructions would further boost its adoption worldwide.

BIMERR will design and develop a Renovation 4.0 toolkit which will comprise tools to support renovation stakeholders throughout the renovation process of existing buildings, from project conception to delivery. It comprises tools for the automated creation of enhanced building information models, a renovation decision support system to aid the designer in exploring available renovation options through an accurate estimation of renovation impact on building performance as well as a process management tool that will optimize the design and on-site construction process toward optimal coordination and minimization of renovation time and cost.

At the heart of the BIMERR toolkit lies an interoperability framework, which will enforce semantic interoperability among BIMERR tools as well as with third-party legacy ICT tools to enable seamless BIM creation and information exchange among AEC stakeholders in an effort to enhance the rapid adoption of BIM in renovation of the existing EU building stock. The BIMERR toolkit will be validated and demonstrated in 4 buildings in 3 European Member States. Two buildings will be used for pre-validation and implementation refinement and the refined BIMERR toolkit will support the actual renovation design and works in one residential building in Poland and a second one in Spain.

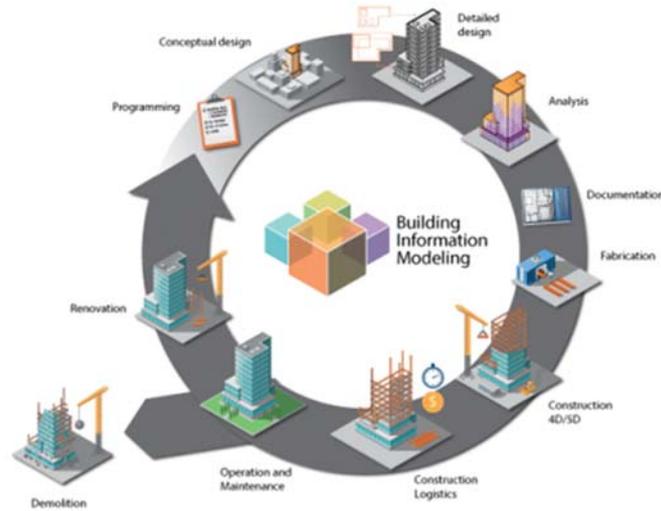
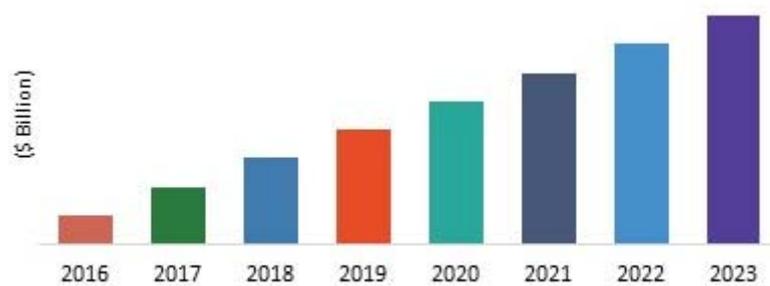


Figure 1 (Above): A basic BIM solution

2.2 Market Potential

Global Building Information Modeling (BIM) Market is expected to garner \$11.7 billion by 2022, registering a CAGR of 21.6% during the forecast period 2016 - 2022.

Figure 2 (below): European Building Modeling Market Value, 2016 - 2023



Source : IndustryARCAnalysis, Expert Insights

Enhanced data communication and coordination among various stakeholders coupled with improved construction productivity provides a leading edge to the BIM users. However, the high cost of software and a limited number of trained professionals are hindering the market growth to an extent.

Technological advancements to manage data at a remote server and improved user inter-coordination enabled effectively by cloud-based solutions have created ample opportunities for the market growth. Recently launched mobile applications by market leaders such as Autodesk, Inc. and Bentley Systems, Inc., to provide better access to their services have been widely accepted among customers, owing to their superior advantages over traditional CAD software. BIM encourages the development of green buildings through energy simulation and prefabrication techniques with effective data exchange during the development of a project, thereby propelling the market growth.

World BIM market is segmented based on the solution, software deployment type, end user, vertical and geography. BIM has been increasingly adopted across different verticals encompassing commercial, residential, institutional, industrial and infrastructure. The adoption rate among commercial and infrastructure is growing rapidly owing to mandates in accordance with government regulations. BIM software models are either delivered through the cloud or on-premise modes to the customers. Cloud-based solutions are gaining increased popularity among customers owing to cost-effectiveness and easy access to on-premise models.

One particular area where standardisation on BIM is needed is the exchange of information between software applications used in the construction industry. The leading organisation in this domain is buildingSMART which has developed and maintains Industry Foundation Classes (IFCs) as a neutral and open specification for BIM data model. Other standardisation work include data dictionaries (International Framework for Dictionaries Libraries) and processes (data delivery manuals).

Although BIM was originally devised for buildings the benefits such as less rework, fewer errors, enhanced collaboration, and design data that can ultimately be used to support operations, maintenance, and asset management made it an attractive option also for infrastructure projects. As geographic information system (GIS) is a key element in any infrastructure project there is the need to integrate BIM and GIS. Both technologies use standard and open data formats, but they are different and presently there is no direct translation.

2.3 BIM Value proposition

Three-quarters of Western European BIM users (74%) report a positive perceived return on their overall investment in BIM, and report a higher ROI than those who base their judgment only on perception. In Western Europe almost half of BIM users report that they measure ROI on more than 25% of their projects. The commitment to measure ROI and the experience of higher ROI are both linked directly to the BIM users' experience level.

- Only 18% of BIM beginners report formally measuring ROI and only 46% report that they perceive ROI to be better than break-even.
- 58% of BIM experts measure ROI and 80% report positive ROI, with 25% citing greater than 100%. This improvement in ROI based on experience level, although architects report the greatest ROI, the markets diverge sharply when it comes to engineers and contractors.
- In Western Europe nearly 70% of engineers report positive ROI.

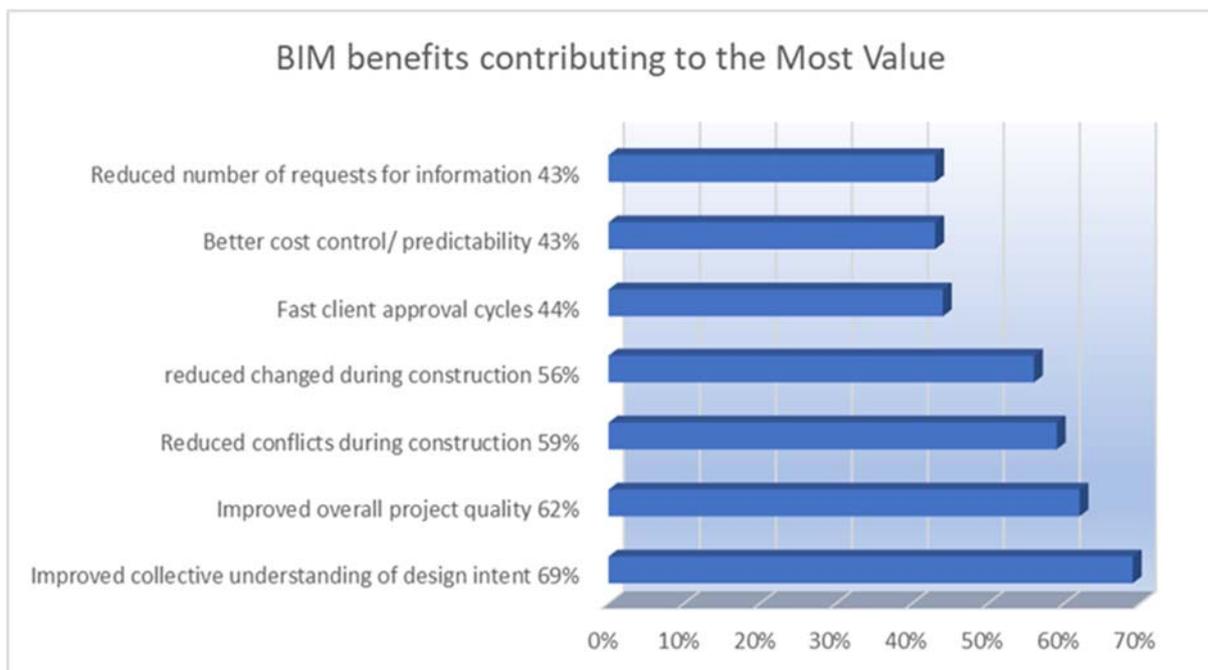


Figure 3 (a): BIM benefits contributing to the Most Value

**Source, from McGraw-Hill construction*

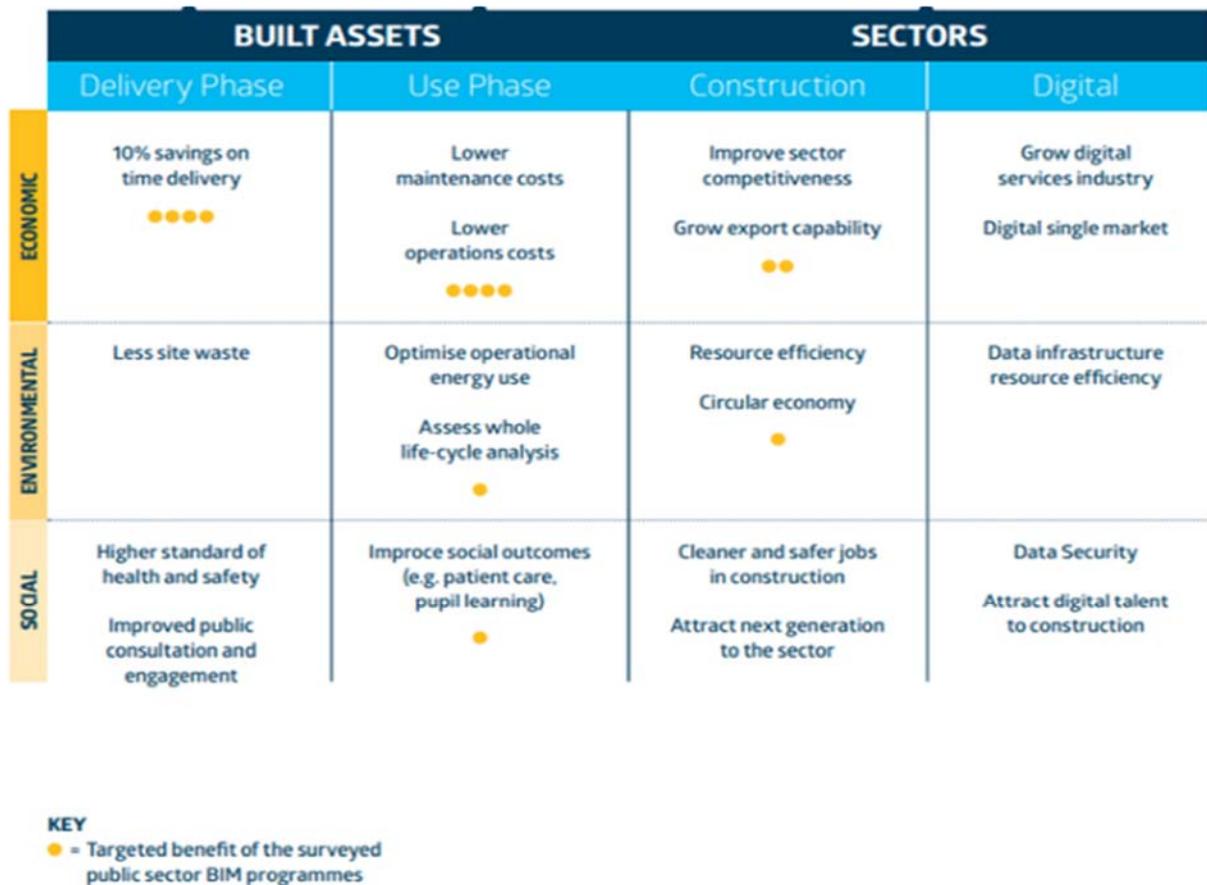


Figure 3 (b): BIM benefits contributing to the Most Value

*Source, from McGraw-Hill construction

3 BIM Mandates and Regulation

There has been an increasing interest from companies, academics, professionals and governmental institutions to compare how BIM is implemented across geographies. Such comparisons are important for transferring lessons across national and regional boundaries and creating a more balanced understanding of digital transition across the construction sector in Europe.

These needs have led to the emergence of several targets, mandates and national strategies to encourage a common language of BIM and influence professionals in the built environment sector in their shift towards digitalisation.

3.1 BIM Mandates

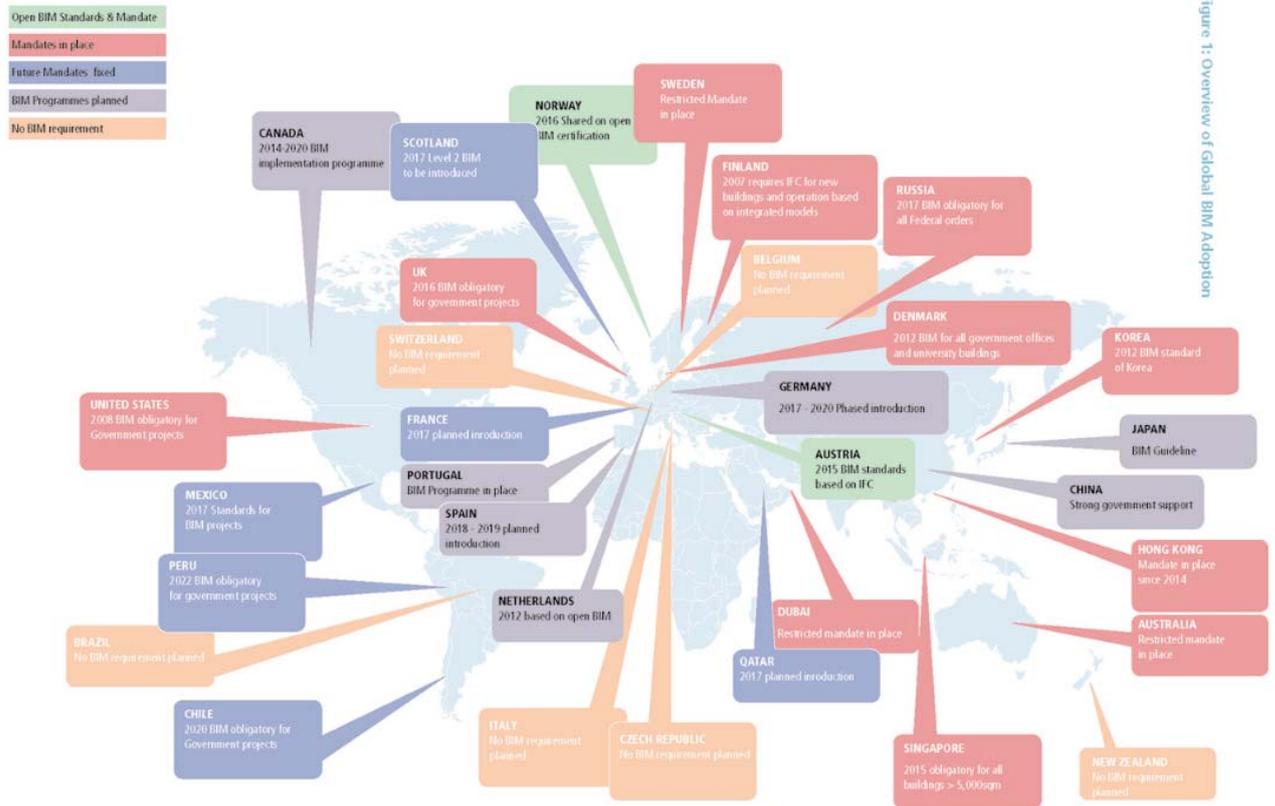


Figure 1: Overview of Global BIM Adoption

Figure 4: BIM Mandate Map

*Source, stroma

Table 3: BIM Mandates by Country

Austria	Likely to be in place 2018
Belgium	No regulation to-date
Brazil	Roadmap under review / consideration
Canada	No regulation to-date
Chile	BIM Mandated for 2020
China	BIM required through the 12th national Five-Year Plan
Czech Republic	No regulation to-date
Denmark	Mandatory requirement since 2007 (extended adoption in 2011)
Dubai	Mandated since 2013
Finland	Senate Properties 2007 Finish Transport Agency – Inframodel 3 (LandXML) (2014)
France	Mandated for 2017
Germany	Mandated for 2020
Hong Kong	Mandated in place since 2014
Ireland	Roadmap to Digital Transition for 2018 to 2021
Italy	Mandated for 2019
Netherlands	No Mandate
New Zealand	No regulation to-date
Norway	Mandated since 2016
Portugal	No BIM requirement planned
Qatar	No regulation to-date
Scotland	Mandated for 2017
Singapore	Mandate in place since 2015
Spain	Mandated for 2018
Sweden	Mandated for Swedish Transportation Administration
Switzerland	No Regulation to-date
United Kingdom	Mandated since 2016
USA	Multiple Mandates through different states

Information reproduced from: McAuley, B., Hore, A. and West R. (2017) BICP Global BIM Study – Lessons for Ireland’s BIM Programme Published by Construction IT Alliance (CitA) Limited, 2017. doi:10.21427/D7M049

3.2 Internationalising UK standards

As the UK National Standards Body, BSI manages over 1,200 committees, comprising over 11,000 committee members. With the help of these committees, BSI is responsible for maintaining over 39,000 standards, most of them originating from Europe (CEN/CENELEC) and internationally (ISO/IEC), and covering most UK industry sectors. BSI can and has used this breadth of sector coverage and global reach through ISO and CEN to take UK best practice globally, thereby positioning the UK industry as thought leaders. Again, BIM is an example of this.

BSI, in collaboration with global partners in international technical committee ISO/TC 59/SC13, put forward PAS 1192-2 to be used as the basis for two international BIM standards:

- ISO 19650-1 Organisation of information about construction works - Information management using building information modelling - Part 1: Concepts and principles.
- ISO 19650-2 Organisation of information about construction works - Information management using building information modelling - Part 2: Delivery phase of assets.

3.3 Legal and Regulatory in Europe

Government policies and Legislation are measures that are stimulating the use of BIM as well as the renovation sector.

EU climate and energy legislation related to buildings:

1. Directive (2003/87/EC) - ETS directive (EC,2003).
2. Directive (2009/29/EC) - ETS directive (EC, 2009-a).
3. Decision (No 406/2009/EC) – ESD(EC,2009-b)
4. Regulation (No 525/2013) - MMR (EC, 2013-a)
5. Directive (2012/27/EC) – EED
6. Directive (2010/31/EC) – EPBD (EC, 2010-a)
7. The delegated regulation (No 244/2012) – (EC, 2012-b)
8. Directive (2009/28/EC) – RED (EC, 2009-c)
9. Directive (2009/125/EC) – Ecodesign directive (EC, 2009-d)
10. Directive (2010/30/EU) – labelling directive (EC, 2010-b)
11. Directives (2009/72/EC) – IME (EC, 2009-e)
12. Directives (2009/73/EC) – IMG (E,2009-f)

13. Regulation No 651/2014 – Internalt market(EC, 2014-d), & (EC,2014-e)

14. Regulation No 1311/2013 – MFF (EC, 2013-b)

4 EU renovation sector

Buildings account for 40% of the EU's energy consumption, 36% of its CO2 emissions and 55% of its electricity consumption. This makes emissions and energy savings in this sector vital to meeting the EU's climate and energy targets.

The Below charts summaries the EU renovation sector:

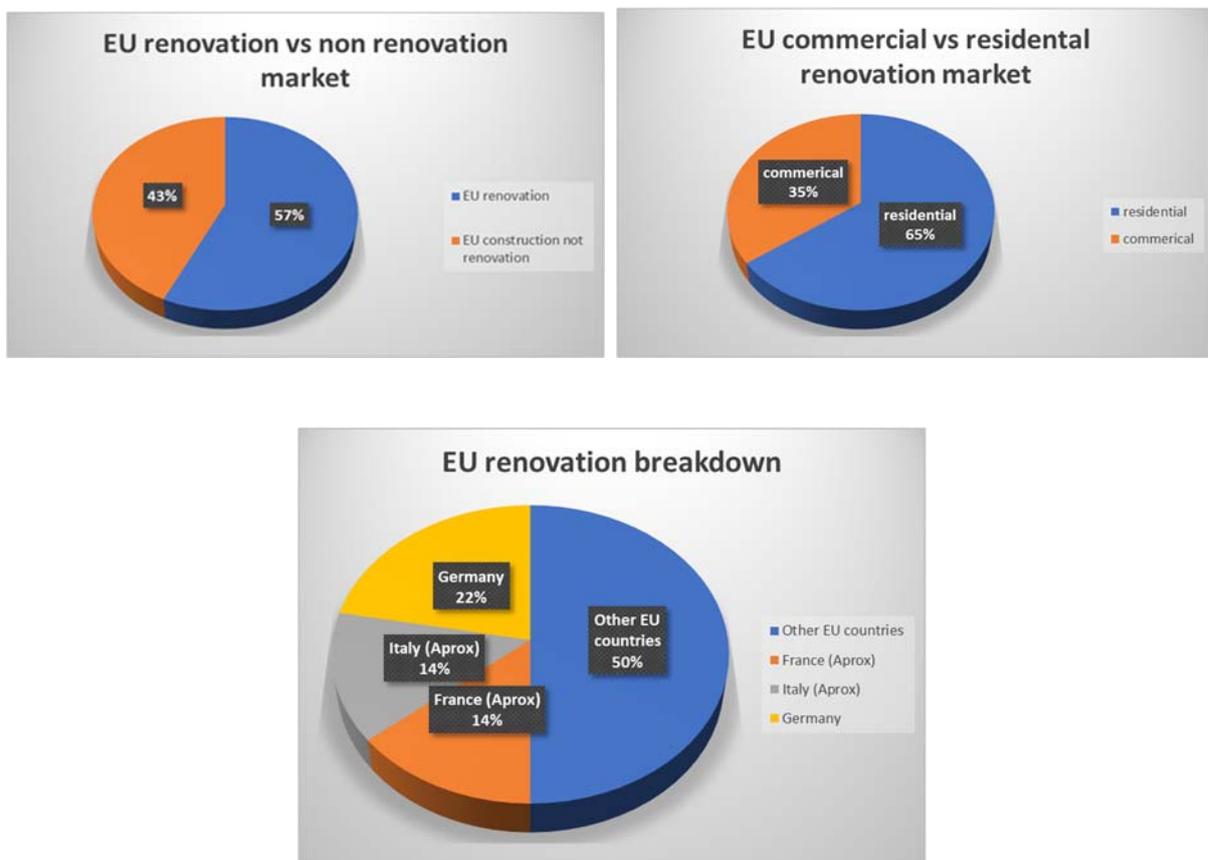


Figure 5: EU Renovation Sector

*Source, Exergy own source

The stock of buildings in the EU is relatively old, with more than 40% of it built before 1960 and 90% before 1990. Older buildings typically use more energy than new buildings. The rate at which new buildings either replace this old stock, or expand the total stock, is low (about 1% a year). This implies that if the energy consumption of buildings is to be reduced the renovation of existing buildings is key.

The current renovation rate of existing buildings is low, with only about 1- 2% of the building stock renovated each year, although it is estimated that renovation accounts for 57% of all construction activity. The vast majority of these renovations do not utilize the full potential energy savings that could be achieved.

A recent study estimated that the EU energy renovation market was worth approximately EUR 109 billion in 2015, consisting of 882,900 jobs. The French, German and Italian energy renovation markets account for almost half of the EU total. The German market is by far the largest, accounting for 22% of the total.

Renovation accounts for 57% of the total construction market, with residential buildings, account for 65% of the renovation market in 2015. It has been estimated that the annual investment in the energy renovation of the building stock will need to grow from EUR 12 billion (~30 € per capita) (in 2014) to EUR 60 billion (~150 € per capita) in order to meet the EU target of a 20% energy efficiency improvement by 2020.

Considering the age profile of buildings in the EU (35% of the EU's buildings are over 50 years old) and the slow replacement rates, the renovation potential of buildings in the EU is huge - up to 110 million buildings could be in need of renovation (based on the estimates that count 210 million buildings in the EU).

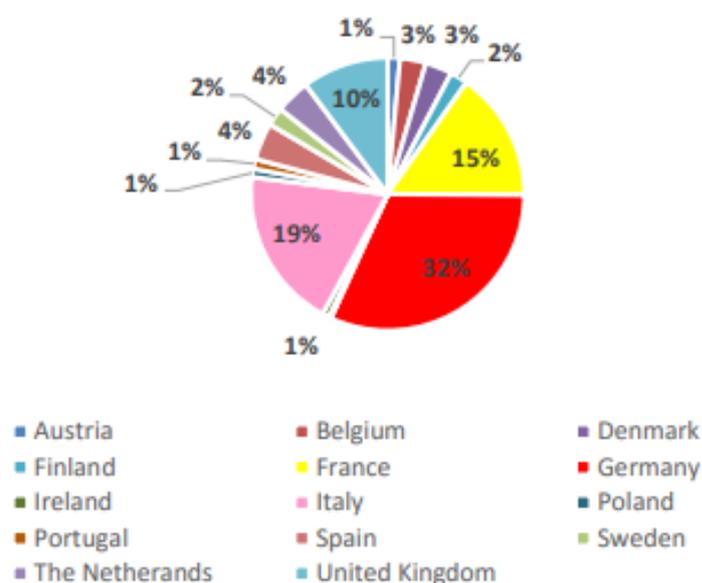


Figure 6 (a): EU Countries share of energy renovation market per segment – Residential

*Source, Euro Construct

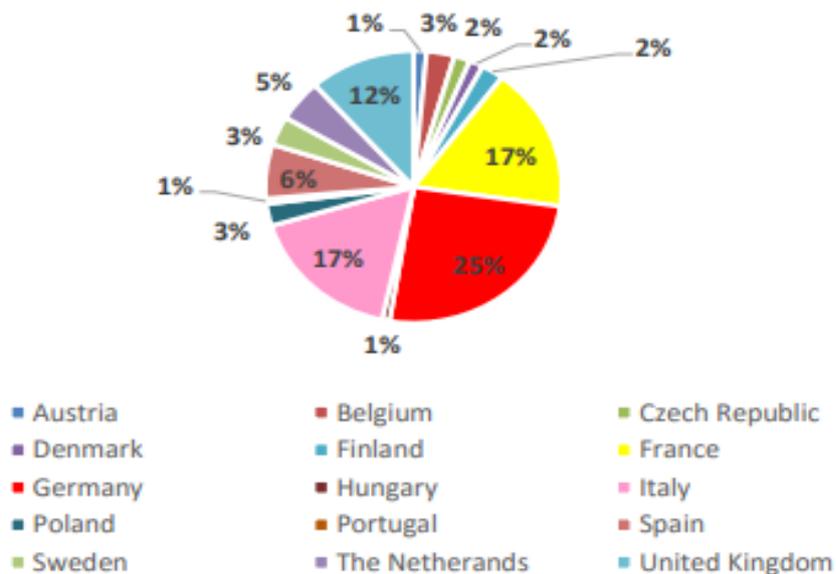


Figure 6 (b): EU Countries share of the energy renovation market per segment, Non-Residential

*Source, Euro Construct

From the above graphs, Germany is leading in the energy renovation of both residential and non-residential buildings, followed by Italy for the residential market and Italy and France for the non-residential one.

Table 4: Share of the renovation market per building segment and country

Country	Residential market			Non-residential market		
	2005	2009	2015	2005	2009	2015
Austria	38%	38%	32%	34%	34%	28%
Belgium	53%	55%	61%	39%	37%	39%
Czech Republic	25%	24%	37%	36%	32%	40%
Denmark	66%	71%	82%	40%	39%	45%
Finland	40%	50%	60%	40%	39%	44%
France	51%	54%	59%	52%	51%	54%
Germany	63%	66%	70%	46%	46%	61%
Hungary	30%	38%	66%	25%	27%	46%
Ireland	17%	49%	57%	19%	17%	12%
Italy	58%	63%	82%	53%	56%	69%
Poland	37%	31%	30%	31%	26%	27%
Portugal	29%	33%	66%	16%	16%	29%
Slovak Republic	24%	20%	38%	20%	21%	31%
Spain	29%	39%	59%	34%	35%	53%
Sweden	57%	62%	60%	73%	74%	61%
The Netherlands	47%	49%	58%	46%	45%	50%
United Kingdom	57%	64%	49%	36%	33%	29%
EUROCONSTRUCT area	49%	56%	63%	42%	41%	48%

*Source, EuroConstruct

Table 5: Estimated size of energy renovation market by EU country

Million €	Residential energy renovation market	Non-residential energy renovation market	Total energy renovation market
Austria	766	412	1178
Belgium	1622	880	2501
Czech Republic	169	505	674
Denmark	1675	441	2116
Finland	1098	705	1803
France	8099	4948	13047
Germany	16750	7321	24071
Hungary	161	236	396
Ireland	418	38	456
Italy	10084	4903	14987
Poland	526	760	1286
Portugal	608	176	784
Slovak Republic	63	94	156
Spain	2317	1862	4178
Sweden	1147	993	2140
The Netherlands	2159	1434	3592
United Kingdom	5396	3342	8737
EUROCONSTRUCT area	53055	29046	82101

*Source, EuroConstruct

From the above tables Germany, Italy and France markets lead the EU energy renovation market, these markets could be highly competitive for the Bimerr toolkit, as we could assume that these countries already use BIM technologies within their renovation sector.

5 Spain

5.1 Market Potential

There are 11,894,635 commercial properties in Spain, the breakdown is illustrated below, currently the percentage of renovations carried out are 1% per year, making the Spanish renovation market potential of 118,946 commercial property renovation as a baseline figure with the opportunity to use the BIMERR toolkit. The analysis preceding shows that renovation in Spain represents a strategic opportunity. Beyond the statistical data, other elements show the opportunities of all kinds that go along with it.

Table 6: No. of properties by uses and decade of construction - Spain

	NO OF PROPERTIES BY USES AND DECADE OF CONSTRUCTION												TOTAL
	Before 1900	1900-1920	1921-1940	1941-1950	1951-1960	1961-1970	1971-1980	1981-1990	1991-2001	2002-2011	Since 2012 (*)	Other (**)	
RESIDENTIAL													23 142 267
V - Residential	437 912	1 237 387	944 525	661 857	1 278 305	3 123 052	4 185 544	2 938 095	3 728 153	4 419 507	76 738	111 192	23 142 267
NON-RESIDENTIAL													11 894 635
TERTIARY, SERVICES AND PUBLIC FACILITIES													1 967 237
O - Offices	1 999	5 898	5 981	5 590	10 328	36 178	51 190	36 706	56 613	71 932	593	344	283 352
C - Commercial	13 401	36 134	35 686	25 735	59 062	211 028	280 036	213 446	235 776	181 623	2 356	1 076	1 295 359
K - Sports	177	704	597	823	1 779	5 872	12 874	13 846	11 620	8 777	240	617	57 926
T - Entertainment	147	433	380	303	425	666	904	765	707	380	10	183	5 303
G - Leisure and Hospitality	1 598	4 340	3 019	2 076	4 418	17 556	45 028	64 020	28 005	24 475	172	2 161	196 868
Y - Health and Charitable	424	1 147	1 137	958	1 506	3 993	8 346	7 886	6 483	5 133	117	252	37 382
E - Cultural	1 151	2 853	3 131	2 820	4 965	8 269	9 315	5 843	4 305	4 139	96	695	47 582
R - Religious	11 605	14 788	2 958	2 025	1 848	2 392	2 561	1 464	1 166	974	86	1 598	43 465
INDUSTRIAL													1 703 522
I - Industrial	106 613	272 072	120 087	80 468	90 744	152 938	231 222	202 719	207 094	155 928	2 149	81 488	1 703 522
WAREHOUSE - PARKING													7 984 295
A - Warehouse - Parking	24 156	74 466	46 550	33 266	61 810	263 439	1 005 188	1 166 184	2 159 091	3 092 778	49 344	8 023	7 984 295
OTHER													239 581
M - Urban design and gardening	3 205	9 213	3 349	2 037	2 004	3 878	35 541	6 130	10 975	30 064	922	39 771	147 089
P - Singular building	1 216	2 535	1 642	1 313	1 430	1 775	3 319	2 443	6 978	2 086	46	483	25 266
B - Agricultural warehouse	281	863	593	458	735	949	1 884	1 176	717	969	5	170	8 800
J - Agricultural industrial	2 273	7 840	4 906	3 939	4 101	5 731	12 753	8 043	5 031	2 316	12	1 481	58 426
Z - Agricultural													

(*) Includes properties whose year of construction is 2012 or 2013.

(**) Any properties whose year of construction is zero, or after 2013.

NB: The data refer to the month of September 2013 and are those provided by the Ministry of Finance and Public Administrations (Directorate General of the Land Registry) for all national territory, except the autonomous communities of the Basque Country and Navarre.

Source: Prepared by the Ministry of Development, based on the Directorate General of the Land Registry.

The commercial sector is overall, receptive to interventions regarding energy efficiency, given the attractive profitability of the investments, although implementing energy renovation projects is still currently not a widespread practice. This is since energy efficiency often competes with other investments and reduces the returns on other investments, such as investment in new equipment.

Investment in energy renovation in buildings can not only contribute to generating a significant volume of employment, reducing the energy bill of the country and the public, as well as reducing energy dependence on energy sources from oil (the price of which is expected to continue rising) –

turn renovating the commercial stock into a strategic opportunity. Investing public resources in renovation – has two major benefits:

- It generates a significant volume of employment, estimated at 18 jobs for each million euros of total investment, or between 54.3 or 56.5 jobs for every million euros of public investment (assuming that 25% of the total investment is subsidized, so that the other 75% would correspond to private investment). At present, reducing unemployment is undoubtedly a notable factor to be considered.
- It generates returns for the public funds that can be estimated to be at least (just considering the VAT and the reduction in unemployment costs) equivalent to the volume of public investment.

5.2 Key Trends

BIM Usage in Spanish commercial sector

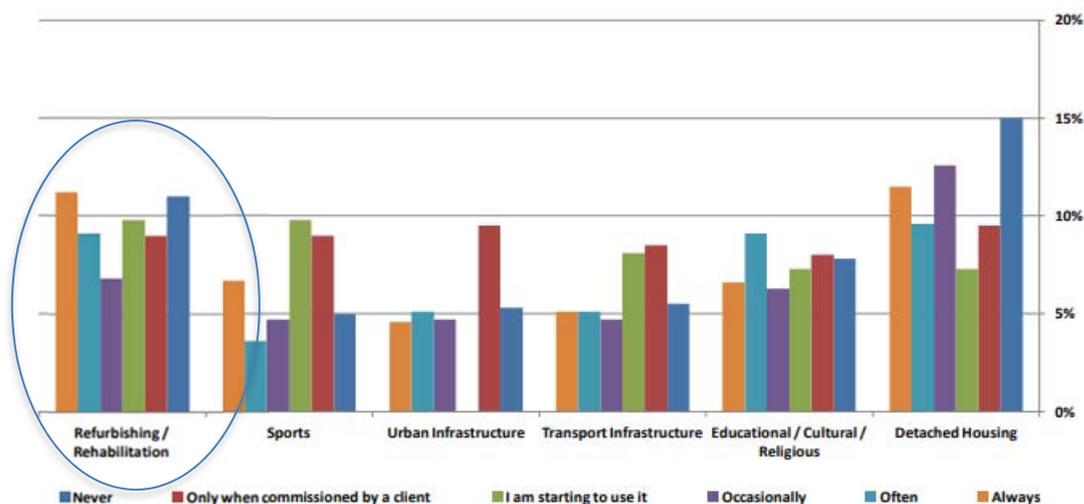


Figure 7: BIM Usage in Spanish commercial sector

Spain is generally advanced in the use of BIM technologies, the above graph (Figure 7) within the commercial refurbishment sector, BIM is used more than other sectors in Spain. Generally, companies have started using it or are always using it. Within the other commercial areas BIM is used less when compared with the refurbish sector.

5.3 PESTEL Analysis

Political and Legal

BIM Mandates

Mandated from 2018

12/03/2018: recommended use of BIM in public works tenders

12/12/2018: mandatory use of BIM in public works construction tenders

26/07/2019: mandatory use of BIM in all public works and infrastructures

Renovation Regulations

European legislation: Existence of clear European guidelines aimed at strengthening energy efficiency and saving emissions. Intention of the European Union (Directives, European funds) and of the central State administration to improve energy efficiency and, in general, the Spanish residential stock.

- The potentialities of Law 8/2013 on urban renovation, regeneration and renewal and its positive assessment by players in the sector.
 - Building Assessment Reports: Existence of a BER Model Ordinance model, which has already been approved and is proving to be very useful for numerous city councils.
 - The positive assessment of Energy Certification and the classification or energy label in the price of properties.
 - The positive assessment of the amendments to Law 38/1999 on Building Planning and RD314/2006 on the Technical Building Code (CTE), as well as the increased flexibility of the Horizontal Property Law by means of Law 8/2013.
-
- Royal Decree 1027/2007, of July 20, by which the Regulation is approved of Thermal Installations in Buildings.
 - Royal Decree 410/2010, of March 31, by which the requisites that are required of the quality control entities of the building and the testing laboratories for the quality control of the building, for the exercise of your activity.
 - Royal Decree 233/2013, of April 5, which regulates the State Plan of promotion of housing rental, building rehabilitation, and regeneration and urban renewal, 2013-2016.
 - Royal Decree 637/2016, of December 9, by which the Plan is extended State for the promotion of housing rental, building rehabilitation, and urban regeneration and renewal 2013-2016 regulated by the Royal Decree 233/2016, of April 5.
 - Royal Decree 235/2013, of April 5, by which the procedure is approved basic for the certification of the energy efficiency of buildings.
 - Correction of errors of Royal Decree 235/2013, of April 5, by which approves the basic procedure for certification of energy efficiency of the buildings.

- Royal Decree 238/2013, of April 5, by which certain amendments are modified articles and technical instructions of the Regulation of Thermal Installations in the Buildings, approved by Royal Decree 1027/2007, of July 20.
- Correction of errors of Royal Decree 238/2013, of April 5, by which are modified certain articles and technical instructions of the Regulation of Thermal Installations in Buildings, approved by Royal Decree 1027/2007, of July 20.
- Royal Legislative Decree 7/2015, of October 30, which approves the consolidated text of the Urban Land and Rehabilitation Law.
- Law 8/2013, of June 26, on rehabilitation, regeneration and renewal urban Thursday June 27, 2013.

Economic

Funding approaches to renovations

As set out by Regulation (EU) No 1303/2013 of the Parliament and of the Council laying down common provisions on the ERDF, Cohesion Fund, EAFRD and EMFF for the period 2014–2020.

Value Added Tax (VAT)

Royal Decree-Law 20/2012 of 13 July on measures to ensure budgetary stability and promote competitiveness sets out the option to apply the reduced VAT rate to certain refurbishment, renovation and repair works.

-The Aid Programme for the energy rehabilitation of existing buildings. (<https://www.idae.es/ayudas-y-financiacion/para-rehabilitacion-de-edificios-programa-pareer/segunda-convocatoria-del>)
http://pareer-res.idae.es/iday_estadistica_resumen_v_list.asp
<https://www.fomento.gob.es/arquitectura-vivienda-y-suelo/politica-de-vivienda/enlaces-comunidades-autonomas-ceuta-y-melilla>

Opportunities for funding and the development of operations

Opportunities from the macroeconomic point of view: Renovation during times of crisis has an anti-cyclical effect on the economy, contributing to improving the economy as a whole by energising the local economy.

- The link between promoting renovation and reactivating the economy, encouraging employment and strengthening the business of small- and medium-sized building firms, allowing them to find new business niches and work for their staff.
- The high percentage of returns on public investment, due to an increase in revenue via taxes (permits, VAT, immovable property tax, etc.) and reduction in unemployment benefits.

- Energy renovation results in energy saving, which means less energy consumption, both at national level (contributing to reducing Spain's energy dependence) as well as for owners (those who better thermally insulate now will have a competitive advantage when the cost of energy shoots up in the years to come).

Residential Incentives

- Subsidies through Royal Decree 233/2013 of 5 April regulating the State Plan to promote rental housing, building renovation and urban regeneration and renewal, 2013–2016.
- The possibility of having loans through the ICO-R3E line for home owners associations.
- Private funding opportunities through public-private partnership arrangements.
- The possibility of energy services companies (ESCOs) funding part of the renovation work.

Technological

Spain has a very large construction industry, with extensive experience and a global vision of the market. There are products and technical solutions are mature within their market and Spain has accumulated experience in Technical Building Inspection.

Spain has availability of labor specializing in construction, refurbishment and renovation and the existence of a multitude of suppliers. They also have a strong fabric of SMEs in the renovation sector, making Spain technologically ready for the adoption of tools like Bimerr.

Companies are interested in investing into renovating energy equipment in cities, buildings and dwellings to improve electricity and gas infrastructures during urban regeneration and renewal actions. As they have seen what BIM tools already do, but the investment cost into technology can be a setback for SME's.

Socio and Environmental

Stakeholder engagement

Spain had for several years a very successful engagement process with stakeholders, through the GTR10 and over the last 2 years, the BUILD UPON Horizon 2020 project. There is, however, no government platform of stakeholders at national level, though some cities are actively promoting stakeholder engagement, with citizen participation, through “renovation roundtables”.

Promoting environmental sustainability and sustainable urban development. Reducing the ecological footprint and improving the environment in general, by reducing the generation of waste, and reducing the material and energy resources used for new construction.

- Renovating buildings and dwellings and regenerating neighborhoods is outlined as the most sustainable solution in the medium and long term, compared to building new dwellings occupying new land. Promoting a more sustainable urban model that improves quality of life in cities and means less pressure on property and land.
- Extending the useful life of buildings and revaluing building heritage. Possibility of improving the aesthetics of buildings, neighborhoods, their environmental quality and reviving socially run-down areas.
- The option of driving R&D&I related to renovation. Advances in research on new materials and development of more efficient appliances (boilers, air conditioners, lighting, etc.).
- Industrializing construction by developing new building systems adapted to renovation.

5.4 Conclusion

Spain has a strong push from government and legislative policy to support the usage of BIM tools within the renovation sector, this is further backed by incentives and funding. They are also technologically ready for the uptake of tools like Bimerr. This is an ideal market for the exploitation of the Bimerr toolkit.

6 Poland

6.1 Market Potential

The low energy performance of existing buildings (especially single-family houses) and use of old coal fired boilers causes significant air pollution - Poland has some of the worst air quality in Europe, with 33 of the continent's 50 most polluted cities, according to World Health Organization (WHO). Despite the potential role of building renovation in reducing emission of pollutants, raising energy security and improving the health and wellbeing of its citizens, Poland does not currently apply sufficient priority to this activity.

Renovating 50% of the existing building stock in the next 20 years would require around €5.3 billion of total annual investment per year, raising the current renovation rate of less than 1% of floor area p.a. to 2.5% p.a. To achieve this would require a reallocation of EU and IFI funding towards energy efficiency in buildings as well as better utilization of the available funds, for example, through financing instruments with higher leverage (i.e. funding from third parties, including building owners and other investors). The European Fund for Strategic Investments (EFSI) and revenues of the EU Emissions Trading System could bring additional funding streams to Poland.

Table 7: Non-residential building type - Poland

Non-residential building type	Total
Warehouse	123,700
Hotels/Restaurants	82,500
Educational facilities	38,900
Cultural facilities	11,400
Health facilities	33,400
Office buildings	18,500
Total	308,400

Table 8: Standard of buildings based in the criterion of thermal insulation, estimation of No. of buildings - Poland

Efficiency level of the building	Number of buildings		Building characteristics
	thousands	% of total	
Very high standard	45	1.2	<ul style="list-style-type: none"> • Modernised/modern installation • Wall insulation minimum 15 cm • Roof insulation • Energy efficient, triple glazed windows
High standard	335	6.7	<ul style="list-style-type: none"> • Modernised/modern installation • Wall insulation minimum 11 cm • Roof insulation • Double glazed windows
Average standard	1,000	20.1	<ul style="list-style-type: none"> • Modernised/modern installation • Wall insulation 8-10 cm • Roof insulation • Double glazed windows
Low standard	1,700	34.0	<ul style="list-style-type: none"> • Buildings with wall insulation layer thinner than 8 cm
Very low standard	1,900	38.0	<ul style="list-style-type: none"> • Uninsulated buildings

*Source: Energy Efficiency in Poland, IEE, Cracow, 2014

6.2 Key Trends

Currently, the use of BIM is not mandatory in Poland. The implementation of BIM is mainly driven by the private sector. The BIM standards have already been adopted by the private sector, however their application is voluntary.

Currently 3D design software with the application of BIM technology is used in Poland in numerous linear projects (roads, bridges). However, work on implementing the relevant regulations and standards into the Polish legal system have already commenced. From the point of view of the public sector, the implementation of BIM into public procurement contracts seems most important, so that the State Treasury, as the main beneficiary, can achieve the greatest possible savings within public purpose investments. Undoubtedly, the main area of the BIM implementation is the construction industry.

6.3 PESTEL Analysis

Political and Legal

Art. 4 of Directive 2012/27/EU and includes: an overview of the building stock, based as appropriate on statistical sampling; a section on the identification of cost-effective

approaches to renovations relevant to the building type and climatic zone; policies and measures to stimulate cost-effective deep renovations of buildings, including staged deep renovations; a forward-looking perspective to guide investment decisions of individuals, the construction industry and financial institutions and an evidence-based estimate of expected energy savings and wider benefits.

PN-EN ISO 16739: 2016-12 - English version

Industry Foundation Classes (IFC) for data exchange in construction and facility management.

This International Standard defines the conceptual scheme of data and the format of the data exchange file for BIM technology (building object information modeling). The conceptual scheme is defined in the EXPRESS language.

This International Standard is an open standard related to data for BIM technologies that are exchanged and shared in computer applications used by various participants in the construction sector or in project management.

The scope of this International Standard is as follows:

- Definitions of BIM data exchange format that are required during different phases of the building life cycle.
- Definitions of the BIM data exchange format that are required by various fields related to different phases of the building's life cycle.
- Definitions of the BIM data exchange format.

Poland is at an early stage of BIM adoption. The Polish government has recently introduced policies and instruments supporting BIM implementation in its construction industry. The BIM adoption rate is relatively low, with only 12% of construction companies using BIM in their daily work. They do so mainly for activities relating to visualization, 3D models, and to a lesser extent for collision detection and use of schedules or optimization. This low adoption rate is partly explained by the lack of knowledge, the absence of (systematic) BIM requirements in public procurement law, and the high cost of BIM initial implementation.

However, BIM implementation in the Polish market has a strong potential with the Polish construction market partly driven by the new construction (rather than renovation works). Other sectoral factors such as labour shortage, and external factors such as increasing price

of materials and external competition, may push the Polish construction industry to implement BIM.

Public Procurement

The Polish government have a binding but flexible approach in regards with BIM implementation. An amendment to the public procurement law was published in 2016, stating, that “in the case of construction contracts, the contracting authority may require the use of electronic data modelling tools or similar tools. In this case, the project’s owner needs to make the access to such tools available until such tool becomes publicly available”. Therefore, the Polish government does not require BIM on a systematic basis, since the publication of the amendment, the Polish government (including its agencies) have published two tenders including BIM aspects in 2017.

Education, research and development

The Polish government invested in BIM education, training and awareness raising. Some universities such as the Warsaw University of Technology developed courses relating to BIM (“Implementation of BIM in Structural Design” and “BIM in Digital Construction”). The courses have become one of the most highly ranked courses. The aim of the courses is to demonstrate the BIM process and how it is realized in a practical way.

Polish government seems to show limited awareness of BIM benefits. According to RICS, BIM implementation barriers from public authorities’ perspective include:

- Additional cost can exceed additional value.
- Limited proof of value for BIM.
- SMEs can be marginalized during tenders.
- There seems to be limited exchange between the industry and the public sector, beyond general BIM workshops and seminars.
- Governments faces more difficulties engaging SME’s and the businesses in the operation and maintenance stages of the construction value chain.
- Poland Government had limited success in engaging and fostering private sector demand for BIM construction projects, which remained rather low.

Economic

Poland is the largest beneficiary of EU funds under the 2014-2020 Multi-annual Financial Framework (MFF), receiving nearly €80 billion from the Cohesion Policy budget over the 7-year period. Only 2.8% of this funding, some €2.2bn, is dedicated to energy efficiency in buildings, compared to the EU average of 3.9%. Additionally, international financial institutions (IFIs), notably EBRD, EIB and the World Bank, direct €27 billion to Poland, while only 1.3% of the total committed amount is allocated to building renovation.

Financial support for the renovation of single-family buildings was in preparation in 2014, but the proposed scheme was eventually shelved. Beginning of 2017, the government promised a new support programme for single-family buildings in the form of preferential credits along with subsidies for the energy poor.

Table 9: Modernization and programme type in Poland

Programme	Name	Residential – Single-family	Residential – Multi-family	Non-residential – Private	Non-residential – Public
A	Thermo-renovation and Repairs Fund	X	X	X	X
B	“RYŚ”	X			
C	Air protection	X	X	X	X
D	“KAWKA”		X		X
E	Energy-saving investments in SMEs			X	
F	OP Infrastructure & Environment		X	X	X
G	ROP		X	X	X

Table 10: (Below) Available financing schemes, scale of funding available

Building type	Available financing schemes	Scale of funding available to 2020
Residential buildings		
Single-family	B - RYŚ	€95.2M
	A - Thermo-renovation Fund	€4.9M
	C - Air protection	€14.8M
		€114.8M
Multi-family	A - Thermo-renovation Fund	€228.9M
	F – OPI&E	€225.6M
	G - ROP	€481.1M
	C - Air protection	€125.5M
	D - KAWKA	€133.3M
	€1,194.4M	
Non-residential buildings		
Industrial	E - Energy-saving investments C - Air protection	€14.3M
Commercial		€59.0M
		€73.3M
Educational	A - Thermo-renovation Fund F – OPI&E G - ROP C - Air protection D - KAWKA	€9.7M
Health		€165.9M
Public administration		€985.8M
		€479.7M
	€57.2M	
		€1,698.3M
Other - including religious establishments	C - Air protection	€59M
TOTAL		€3139.8M = €628M/a over the period 2016-2020

The unavailability of long-term loan for renovation projects: The absence of long-term, readily available and moderately priced financing schemes significantly hinders the possibility of conducting comprehensive renovation activities.

Technological

The low level of contractor knowledge: (construction companies, architects, construction site managers) which translates directly into errors in projects, the selection and implementation of technological solutions and, as a result, the parameters of the buildings erected, including further costs for mistakes and inefficient processes. Users are not fully conversant with the use of good digital technologies.

The technological benefits for new generations of BIM : BIM and new technologies are significant for the construction sector in Poland as the new generation of students and entrants to job market expect to be able to connect to the world and communicate with the environment using smartphones and social media. Many sectors offer such tools to their employees. Whether these are tablet applications allowing remote work or signing contracts through banks (fintech), it is the world of the new generation. If the construction and infrastructure sectors want to attract talent, they have to become appealing, they have to become 4.0. The BIM philosophy and technology is a very good response to these needs.

Socio and Environmental

The social benefits primarily result from the limitation of energy poverty and social exclusion. According to various estimates, energy poverty (i.e. a situation where the costs of ensuring the correct temperature in premises, both in winter and in summer, exceed the household budget from 10% to 20%) threatens 16%–25% of households in Poland (data from “Survey on Income and Living Conditions in the EU” 2012). Comprehensive thermal modernisation could lead to a decrease in heating (or cooling) costs of premises by as much as half, and therefore contribute not only to the improvement of comfort of life, but also to an increase in household disposable income.

The environmental benefits result from a decrease in local air pollution and carbon dioxide (CO₂) emissions which lead to climate change. According to analyses by experts from Building Performance Institute Europe (BPIE), the potential decrease in greenhouse gas emissions by 2030 (as compared to 2010), accomplished as a result of thermal modernisation of buildings, may reach from 8% to 59%. Along with the improved energy efficiency of buildings, air pollution resulting from the so-called low-stack emission, i.e. burning solid fuels in inefficient household furnaces, will also drop significantly. Comprehensive thermal modernisation, preferably combined with a replacement of local heat sources and, in certain cases, with a ban on coal burning, may greatly reduce the demand for energy from low efficiency furnaces and, in turn, limit the emission of harmful substances.

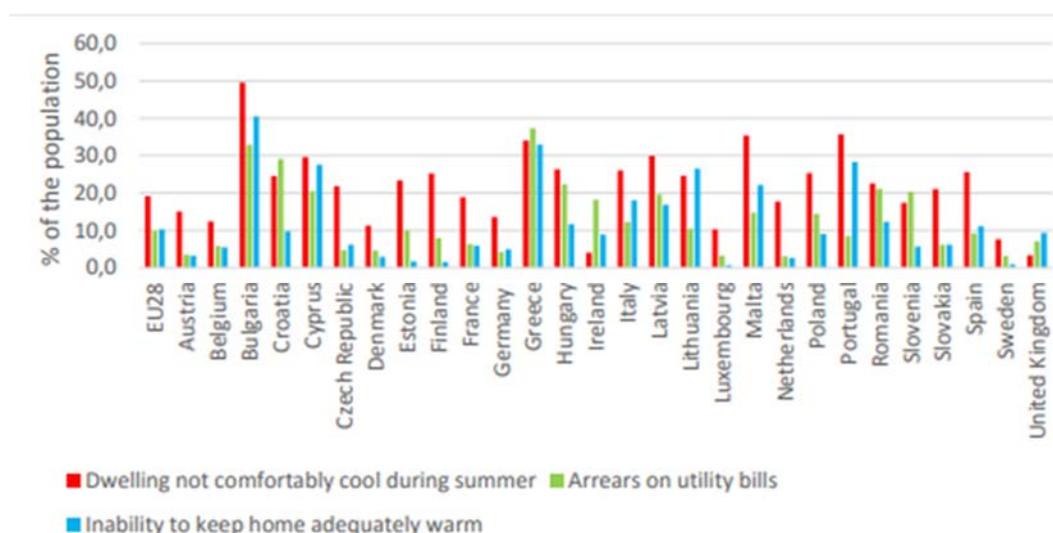
6.4 Conclusions

Poland is at early stage development of BIM solutions and the adoption rate is low, there is not enough government support to push the usage of BIM tools, and this is generally due to lack of knowledge and education. There is a low level of financial incentive for energy renovations and it is not mandatory to use BIM tools to renovate. Poland Government had limited success in engaging and fostering private sector demand for BIM construction projects. As for now Poland does not seem like a strong market for the exploitation of the Bimerr toolkit.

7 Heating or Cooling Renovations

7.1 EU

The below data shows the requirement for heating or cooling needs in EU member countries, both Spain and Poland have a population of over 25% that cannot keep their dwelling comfortably cool during summer. However, Spain has a slightly higher percentage of population that has inability to keep home adequately warm in winter. Poland has a larger percentage of population who have arrears on utility bills. Therefore, the greatest need of both countries requires more energy efficient cooling renovations, but similar levels of heating renovations. It can be assumed that Poland has a larger problem of energy efficient buildings as the arrears on utility bills are higher, assuming that their current buildings are not very energy efficient.



The Percentage of population unable to keep their homes warm in winter and with arrears in their utility bills is given for 2014, while the percentage population living in homes not comfortably cool in summer is given for 2012.

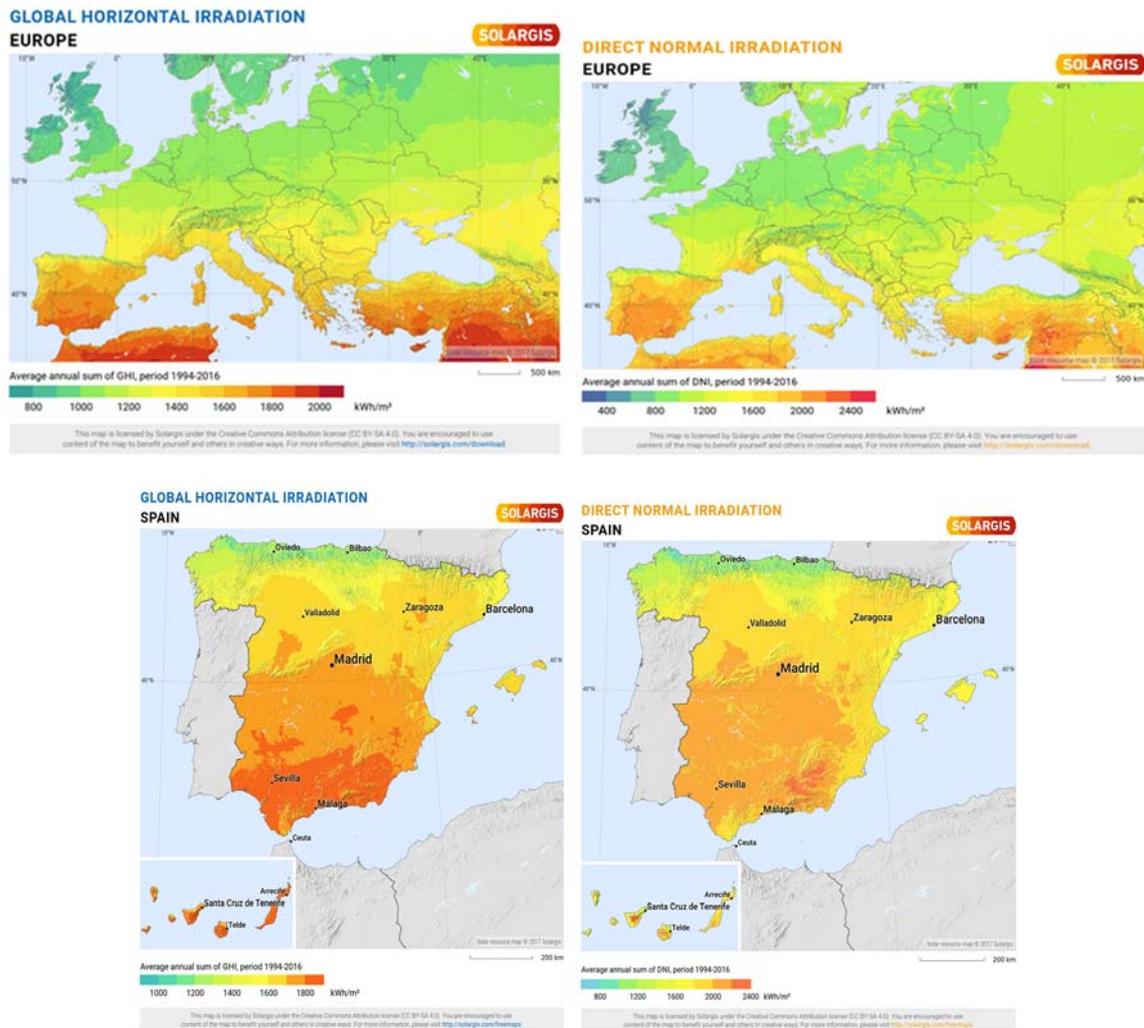
Figure 8: Indication of types of renovations in EU Countries

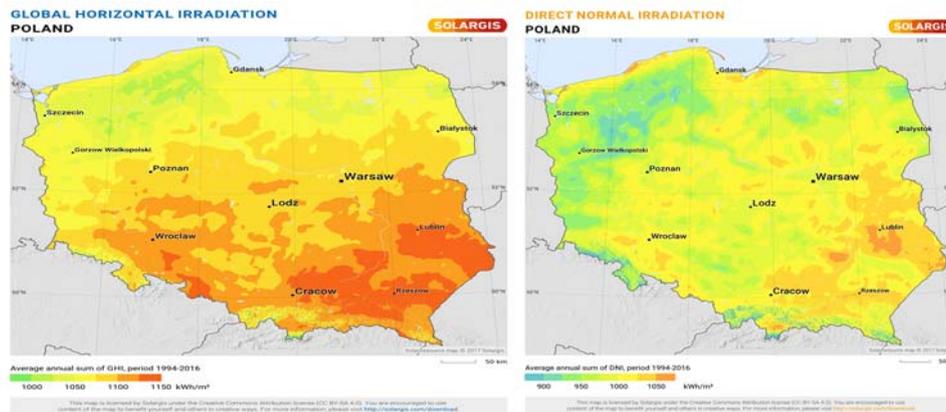
*Source, Eurostat SILC database

7.2 Thermal Maps, Irradiation Levels

Another indicator of the types of renovation requirement for EU countries including Spain and Poland, can be determined from the Irradiation levels. Generally, from the map below, the warmer the country is, the higher the requirement for energy efficient cooling of buildings, with the southern countries being generally warmer than the northern. Regarding Spain and Poland, Spain has higher temperatures than Poland, but, from Figure 8 above, both countries have similar levels of inability to keep dwelling cool in summer. From the aforementioned, it can be concluded that Poland is less energy efficient than Spain, as Poland is a cooler country, their buildings for cooling should not have a high requirement of cooling, which is also evident by the arrears on utility bills.

Figure 9: Thermal Mapping (Irradiation Levels)





*Source, Solargis

8 Renovation levels and energy savings targeted or expected by EU states

Table 11: EU Country renovation targets

EU State	Target / Estimation	Energy Saving
Austria	Estimated	3% building sector energy use reduction in the 2020, compared to 2013.
Belgium (Brussels Capital Region - BCR)	n/a	n/a
Belgium (Wallonia)	n/a	n/a
Belgium (Flanders)	Estimated	4288 GWh of final energy and 4581 GWh for primary energy saved by 2020.
Bulgaria	n/a	n/a
Croatia (Potential Market for Bimerr)	Targeted	80% reduction of GHG emissions in buildings of national building stock by 2050.
Cyprus	n/a	n/a
Czech Republic (Potential market for Bimerr)	Estimated	77 PJ saving of energy (45% reduction compared to current consumption) for heating in residential buildings.
Denmark	Estimated	35% reduction in net energy consumption for heating and hot water in the building stock by 2050, compared to 2011.
Estonia	Targeted	3.5 PJ/y energy savings in the building sector to be achieved by 2016.
Finland (Potential Market for Bimerr)	Estimated	-8% energy consumption by 2020, -37% by 2050 (- 8115 GWh by 2020, -36889 GWh by 2050).
France	Targeted	38% reduction of energy consumption of buildings by 2020 and 400.000 dwellings per year should be energy renovated starting from 2013.

Germany	Estimated	337 PJ/year energy savings for period 2008-2020.
Gibraltar	Estimated	6.7 GWh of primary energy saved by 2020 and 88.8 GWh by 2050.
Greece (Potential Market for Bimerr)	Targeted	At least 80% of the existing building stock renovated by 2050.
Hungary	Targeted	49PJ/y primary energy saving for the building sector at 2020.
Ireland (Potential Market for Bimerr)	Targeted	A nearly-zero emissions building sector by 2050; %33 reduction of energy usage in the public sector by 2020.
Italy	Targeted; Estimated	4.9 Mtoe/y final energy savings of the building sector by 2020 (3.67 Mtoe/y in the residential sector, 1.23 Mtoe/y in service sector) have been targeted; it is estimated that this could lead to a 24% reduction of primary energy consumption in comparison with the business as usual scenario.
Latvia (Potential market for Bimerr)	Targeted; Estimated	50% reduction of consumption of thermal energy for heating against the current indicator is the target to be achieved by 2030. It is estimated that by renovating 3% of State owned and used building areas each year, 186 GWh energy savings could be achieved over the period 2014–2020.
Lithuania	Targeted	At least 500 GWh of thermal energy to be saved (i.e. for space heating) by 2020.
Luxembourg	n/a	n/a
Malta	n/a	n/a
Netherlands (Potential market for Bimerr)	Targeted	300,000 existing buildings per year to improve by at least two energy label steps; Average social rental property to achieve label B; 80% of private rental to achieve minimum label C by 2020; At least an average energy label A for buildings by 2030.
Poland	Refer to Pestel	
Portugal	n/a	n/a
Romania	n/a	n/a
Slovakia	Estimated	6928.6 GWh energy savings up to 2030.
Slovenia	Targeted	At least 16% final energy consumption in building decreased by 2020; 30% by 2030 (compared to 2005); almost carbon-free energy use in the building sector by 2050.
Spain (Potential market for Bimerr)	Refer to Spain Pestel	
Sweden	Estimated	12-25% reduction of final energy consumption for heating and domestic hot water (DHW) in buildings.
United Kingdom	n/a	n/a

Source: Adapted from Castellazzi L., Zangheri P., Paci D., 2016. Synthesis Report on the assessment of Member States' building renovation strategies. (Data was not available for: Belgium (Wallonia region and BCR), Bulgaria, Cyprus, Luxembourg, Malta, Poland, Portugal, Romania, Spain, United Kingdom.)

9 SWOT Analysis for uptake of BIMMER

Table 12: Bimerr SWOT Analysis

Strengths	Weaknesses
<ul style="list-style-type: none"> -Connecting different but well-suited software modules to an overall system and links well with AutoCAD. -One unique collaboration platform where all stakeholders are involved. -Transparency of information between stakeholders. -The interfaces that we are proposing could easily be highly appreciated. - The main advantage BIMERR can offer to the construction field is the reduction of cost and time by reducing errors and miscommunications between the different stages during the renovation process. - Moreover, a higher level of control, insight and credibility as to the quality and time planning of the project can be provided to the different experts involved at every stage of the process by offering access and allowing the efficient management of the available building information. - Can be used in many EU countries not just Spain and Poland, as there is government push in other EU countries. - BIMERR toolkit offers an interoperability framework. 	<ul style="list-style-type: none"> -Connecting different software modules to an overall system. -Digitalization implies a cost for the client which he might not accept. - As BIM is not part of the common practice in some countries, a long-term investment is required for technology adoption and training of the experts. Companies, especially the smaller ones, are reluctant to adopt it since it requires training their employees, including all the involved parties and not only those that have previously worked with CAD.
Opportunities	Threats
<ul style="list-style-type: none"> -Creating a framework that supports renovation projects by connecting established components. -Large market space in the future, as renovation targets increase. -A number of opportunities for the implementation of the BIMERR toolkit arise due to the national targets for increasing the renovation rate by 2030 and the implementation of multiple regulations regarding the energy efficiency of buildings to achieve this. -Moreover, the legislation defining that the energy performance of a building must comply with certain standards in order to be economically exploited, in combination with the mass increase of seasonal leasing in platforms such as Air BnB for touristic purposes has substantially increased the renovation demand. 	<ul style="list-style-type: none"> -The current regulatory framework is often inconsistent causing administrative problems and delays during the renovation process. -Public authorities' inflexibility can significantly increase the delays and cost of the renovation process. -The lack of education and information of the public in matters of energy efficiency and sustainability costs causes suspicion when it comes to implementing green renovations.

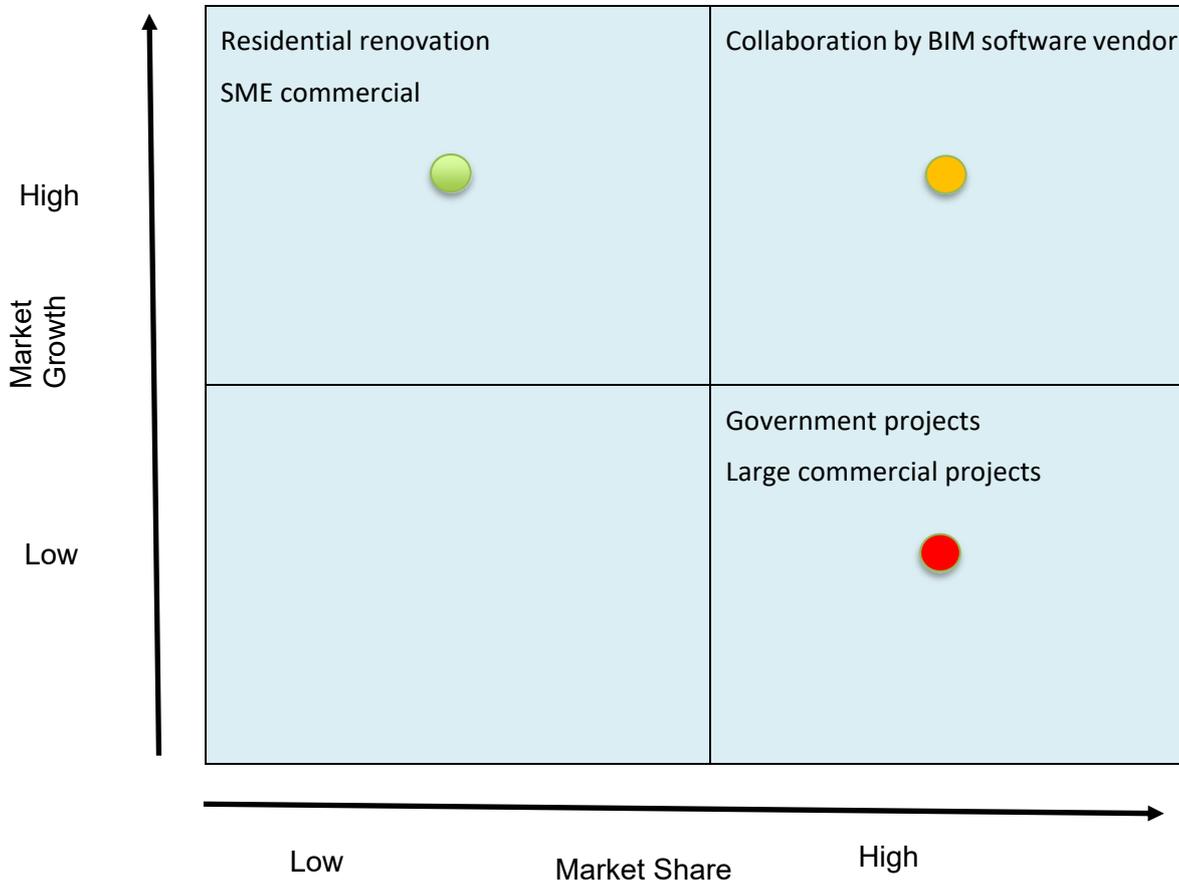
10 EU Market Area's for Bimerr Toolkit

Table 13: EU market areas for Bimerr toolkit

Sector	Countries
Construction Companies Architectural Practices	Croatia Finland Greece Ireland Latvia Netherlands Poland Spain *All based on the renovation for energy efficiency targets 2020 - 2050
Other recommendation	Potential to use BIM in New construction projects and Infrastructure projects.

11 Identification of Key Markets

Plot on BOSTON MATRIX grid



From the analysis within this document, potential markets have been identified for the commercialization of Bimerr. This is plotted against market share and Market growth using the Boston matrix grid.

Key

-  For Bimerr to have high market growth but low market share, the tool would need to be used by SME's on small to medium sized projects, and within the residential sector. For example, this could be an area where the tool would generate many regular sales of small prices, but would not give Bimerr a strong market share. Perhaps some sort of subscription model that will produce small but quick cash flow.
-  For Bimerr to have high market share and high market growth, Bimerr would need to collaborate with a software vendor like AutoCAD. This would allow for larger profits over quicker period of time.
-  For Bimerr to have high market share, but low market growth, Bimerr would need to be used in large commercial and government projects, here the profit margins would be large but the growth rate would be slow.

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Appendices

Table 14: Country profile, legislation and funding

<p>Croatia</p>	<p>To facilitate the renovation of multi-family buildings, approval now requires a simple majority (51%) of residents, whereas previously such decisions needed to be unanimous. Tackling energy poverty is also now taking on greater importance, with three centers dedicated to the task to be established in 2018.</p> <p><i>Legislation and other support measures to tackle barriers:</i></p> <p>In order to facilitate the renovation of multi-family buildings, Croatia amended, now, the approval requirements to a simple majority (51%) of residents, whereas previously such decisions needed to be unanimous. Three centres targeting energy poverty are to be established in 2018, while in the following year, research and local promotional campaigns will be undertaken in all cities with more than 30,000 residents.</p> <p><i>Funding and financial support for renovation:</i></p> <p>Uptake of renovation measures in residential and public buildings is highly dependent on the availability of grants from national or EU sources. While there are currently no grants for the commercial sector, financial support from the European Structural and Investment Funds (ESIF) for trade and tourism is expected to start soon and grants for public sector buildings (schools and kindergartens) are also expected. Public buildings have been renovated using grants and partially through the ESCO model.</p>
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<p>Czech Republic</p>	<p>All categories of buildings in all regions now have dedicated financial support programmes for both renovation and new efficient construction.</p> <p>Funding:</p> <p>In terms of financial support, the renovation strategy contributed to the revision of current programmes and to the creation of new ones such that, in the Czech Republic, all categories of buildings in all regions now have dedicated programmes for both renovation and new efficient construction. That said, some programmes are still far from ideal, such as the multi-family housing Regional Operational Programme, where the process of grant administration is still rather complicated for a typical applicant from a condominium, while others are functioning quite well, e.g. the New Green Savings Programme for single-family houses. However, the process of applying for grant support is still considered difficult by some, although improvements have been made. There is an ongoing debate with the banking sector on launching new financial instruments (like green mortgages) with some kind of State support in the form of guarantees.</p>
<p>France</p>	<p>The French 2015 Energy Transition Law introduced bold new renovation targets with a clear long-term ambition to achieve the BBC (Bâtiment Basse Consommation²) level by 2050 for the entire building stock, with a specific focus on addressing energy poverty. The trigger point “renovation embarquée” has been deployed as well as one-stop-shop advisory services. However, current financial support does not appear to match the ambition.</p> <p><i>Legislation and other support measures to tackle barriers:</i></p> <p>Enacted the 2015 Energy Transition Law with three overarching objectives for the building sector:</p> <ul style="list-style-type: none"> • By 2025, all private residential buildings with primary energy consumption exceeding 330 kWh/m² per year must have been subject to energy renovation; • Renovation of 500,000 homes per year starting in 2017, at least half of which are occupied by low-income households; • All buildings to be renovated according to the BBC “low consumption building” standard or similar, by 2050. <p>At the same time, subnational initiatives to increase advisory services for renovation are introducing innovative solutions such as the Picardie Pass Rénovation. However, the renovation targets are not yet supported by the necessary implementing measures.</p> <p>Funding:</p> <p>The multiplicity/complexity of support schemes is seen by observers as an obstacle to their uptake. Innovative financial schemes, such as third-party financing, are slowly emerging, but issues remain as for the treatment of such schemes. This is also not clear whether the finance required to meet the ambitious renovation targets of the Energy Transition Law is in place. However, initiatives at the subnational level such as Energies POSIT'IF are implementing new approaches to financing.</p>

<p>Greece</p>	<p>Greece introduced two legislative acts to facilitate and reduce the bureaucracy associated with installing energy saving measures. In another interesting move to address the issue of homes built illegally without license, new laws allow the owner to pay only 50% of the fine, while the remaining 50% can be invested in the energy renovation of the dwelling.</p> <p><i>Legislation and other support measures to tackle barriers:</i></p> <p>Introduced two acts – “small scale license” and “48h notification license” – to facilitate and reduce the bureaucracy for small interventions/renovations, including energy saving measures such as boiler change, installation or insulation, heat pumps or new windows. With an amendment of Law 4342/2015, introduced in 2017, individual apartment owners in multi-family or multi-purpose buildings have the right to be disconnected from the building’s central heating system by installing new decentralised natural gas boilers, without needing the consensus of the remaining owners. And, in an attempt to tackle the problem of homes built illegally without license, national laws 4178/2013 and 4342/2015 allow the owner to pay only 50% of the fine while the remaining 50% can be invested in the energy renovation of the same house with at least an upgrade of one energy class or a specific percentage of primary energy savings.</p> <p>Funding:</p> <p>Financial support for building renovation is available under the following schemes, a number of which were introduced prior to the 2014 strategy but which have been subsequently developed or extended:</p> <ul style="list-style-type: none"> • A new financing scheme focusing on the renovation of public buildings was announced, to follow on from its predecessors “Saving” and “Saving II7”. • “Saving at Home8” focused on the renovation of private households. It provided grants in the range 15-70%, coupled with preferential interest rate loans. The main part of this programme has ended; however, some remaining budget still serves the remaining applications. “Saving at Home II” was announced with different criteria and funding schemes as well as easier and faster online application and verification procedures. • Replacement of old oil boilers with natural gas in private buildings, launched in November 2014. This programme provided grants up to 60% of the total cost and up to €5,500 per household. • Extension of the district heating network in four Greek cities has been or is expected to be completed, giving the opportunity to a significant number of buildings to replace their old heating boilers. • Additionally, a new financial support programme for energy efficiency renovation in SMEs was announced. <p>Despite the ongoing and upcoming programmes, a significant financial gap for energy efficiency interventions remains.</p>
<p>Hungary</p>	<p>Hungary introduced a new energy advisory network in 2017 to assist local governments to prepare energy efficiency strategies.</p> <p><i>Legislation and other support measures to tackle barriers:</i></p> <p>Hungary established a new energy advisory network in 2017 to assist local governments to prepare energy efficiency strategies. Large energy users must now employ energy managers and prepare yearly plans for improving their energy using performance, and the Energy Performance Certificate (EPC) has been amended to include recommendations on energy efficiency measures.</p> <p>Funding:</p>

	<p>For public buildings, EU grants are available. For households, a new interest-free loan was launched in April 2017, but funds are only sufficient for 25,000-30,000 households. Furthermore, the artificially-low electricity prices for households do not motivate people to save energy or to switch to renewables. The return on investment periods for sustainable energy projects are simply too long for most people.</p>
Ireland	<p>Ireland has undertaken several actions to overcome some of the barriers identified in the 2014 renovation strategy, including establishing a Behavioural Economics Unit to explore the real motivations and drivers in decision making around renovation.</p> <p>Legislation and other support measures to tackle barriers:</p> <p>Ireland has undertaken several actions to overcome some of the barriers identified in the 2014 renovation strategy, including establishing a Behavioural Economics Unit to explore the real motivations and drivers in decision making around renovation. In another area, the Irish Government proposes to study the feasibility of establishing mandatory minimum thermal efficiency standards for all rented properties. Meanwhile, the Society of Chartered Surveyors Ireland (SCSI) is due to include a new clause in its Business Leasing Code on green leases in December 2017 which could help tackle the split incentive that exists between landlords and tenants. A new register of qualified contractors has been established, complemented by an Energy Skills training programme, to increase confidence in the workforce.</p> <p>Funding:</p> <p>Financial support is in place for residential energy improvements, smart metering, and upgrade of the public building stock, including schools. Grant support for community energy projects has increased by 50%. In the residential sector, two innovative pilot schemes have recently been introduced:</p> <ul style="list-style-type: none"> • The Warmth and Wellbeing Pilot Scheme brings comprehensive energy upgrades to homes inhabited by older people and children with certain clinical conditions. A research project has been running in parallel over the three years of the pilot to establish the impacts of these measures on the health of recipients and whether there is a reduction in their need for health services. • The Deep Retrofit Pilot seeks to explore ways to help homeowners overcome the different barriers to deep retrofit. <p>In the public sector, a strategy was published in January 2017, including a new pilot deep retrofit scheme, with the option for public bodies to retain financial savings arising from energy efficiency improvements to support other areas of their operational budget.</p>
Italy	<p>Italy has a strong focus on financial incentives for renovation, through the annual finance law which regulates tax deductions for energy improvements in private buildings. This innovative tool could have a strong impact to overcome the financial barriers to renovation.</p> <p>Funding:</p> <p>Improvements are ongoing in the area of financial incentives for renovation. This is being delivered through the annual finance law, regulating tax deductions for energy improvements in private buildings.</p>

Spain	Spain had for many years a very successful engagement process with stakeholders, through the GTR3 and over the last two years, the BUILD UPON4 Horizon 2020 project.
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Table 15: Other BIM software solutions on the market

Top 20 best Building Information Modeling (BIM) software solutions	
1	<p>Autodesk BIM 360</p> <p>Overview Autodesk BIM 360, another product by the CAD company, is a project delivery and construction management solution that unifies the processes of project, design, and construction teams. BIM 360 is a cloud-based web service that provides teams access to data to improve decision-making and avoid expensive delays.</p> <p>The tool lets you completely manage your project’s entire lifecycle. Some of Autodesk BIM 360’s main features include a controlled work-sharing environment, design review, deliverable coordination, BIM coordination, change visualization, quality and issue management, safety program checklists, and RFIs and submittals. This package contains numerous modules to provide a 360-degree control of your construction operations.</p> <p>USP’s Why choose Autodesk BIM 360? RFIs and submittals. Activity tracking and tighter project controls for handling submittals packages. Visualization modifications. Get visibility over model versions when combined with extended team models. Design review. Centralizes viewing, marking up and publishing of comments for review.</p>
2	<p>Tekla BIMsight</p> <p>Overview Tekla BIMsight is an easy-to-use construction collaboration software. It expedites how you combine models, check and identify conflicts, and, finally, communicate issues with your team. This solution is built for advanced BIM and structural engineering. By streamlining your construction workflow, you can easily identify and solve issues even during the design phase to ensure they addressed before construction.</p> <p>Some of Tekla BIMsight’s main offerings include 3D navigation, automatic clash detection, mark-ups, IFC support, multiple model viewing, and object or model coloring and transparency, among others. It also runs on Windows 7 and 8 tablet computers with a touch-user interface so you can take your models on-site anytime.</p> <p>USP’s Why choose Tekla BIMsight? Mobile-ready. Available on Windows 7 and 8 tablet devices.</p>

	<p>Academics use. Suitable for students and educational institutions to use for an introduction to model-based design coordination.</p> <p>Free tool. It is available to users for free.</p>
3	<p>Revit</p> <p>Overview Revit BIM Software is a building information modeling tool for structural and MEP engineering, construction, and architectural design. It is one of the most popular software packages developed by the CAD giant Autodesk. Designed for MEP engineers, architects, designers, contractors, and landscape architects, among others, the robust platform offers an intelligent model-based approach for planning, designing, and constructing infrastructures and buildings. It is compatible with Microsoft Windows only.</p> <p>It also minimizes the risk of errors caused by miscommunication as all process goes through a single system. Coordination is also achieved through its multiple project contributors features to avoid rework and clashes. Revit also lets you simulate and reiterate designs for systems and structures. This 4D BIM is capable of tracking the construction's entire lifecycle from conceptualization up to maintenance and even demolition.</p> <p>USP's Why choose Revit? Interoperability. It functions together with members of an extended project team. High impact 3D visuals. The communication of ideas and design intent is delivered to teams and project members. Multi-discipline solution. Built for disciplines such as architects, structural engineers, MEP engineers and construction professionals.</p>
4	<p>Navisworks</p> <p>Overview Navisworks is also built by Autodesk. The difference between Navisworks and Revit is that Navisworks specializes as a project review software tool for AEC professionals. This 3D design review package is compatible only with Microsoft Windows. It complements other Autodesk 3D design packages for opening and combining 3D models, reviewing the model, and navigating around it in real time.</p> <p>This tool is crucial during preconstruction to gain control and ensure a successful project outcome. One of its features includes model coordination and clash detection. This enables you to spot, anticipate, and reduce the potential risk of clash and interference issues. Animation, model simulation, and data aggregation into a single model are some of its main features.</p> <p>USP's Why choose Navisworks? BIM 360 Glue integration. It simplifies the sharing of data and workflows in the cloud with your projects. Faster multi-head clash detection. An update for running clash detection more efficiently and quickly. Highlighted sections. Better visualization through cut plane highlighting.</p>
5	<p>BIMobject</p>

	<p>Overview BIMObject is a BIM content platform available for free. It is a cloud solution used by architects, engineers, constructors, and designers to access manufacturer-specific BIM objects. Users can easily access the platform instantly through filling in the registration form with no limit. You can search for thousands of BIM objects in categories under construction, construction materials, and doors, for a start. There are also various brands, types, file types, and regions. To find the right match, you can narrow down your choices through its advanced filtering options.</p> <p>USP's Why choose BIMObject? Quick registration. Use the platform through a simple registration process. Thousands of BIM objects. You can search and download thousands of options for BIM objects. BIMObject app. By using the app, you can optimize your workflows and downloads in the software.</p>
6	<p>BIMx</p> <p>Overview BIMx is a collection of desktop and mobile software tools to present BIM models in 3D models and 2D documentation. The integrated 2D and 3D building project navigation bridge the gap between the design studio and the construction site. It can be viewed with native viewer applications compatible with operating systems such as Android, Apple iOS, Microsoft Windows, and Mac OS X.</p> <p>This tool offers a Hyper-model concept that gives you quick and direct access to drawing sheets from the 3D building models where the virtual environment is generated from. It has three main applications: publisher, a desktop viewer, and mobile viewer. Additionally, its 3D models are presented in an interactive approach which promotes usability for users.</p> <p>USP's Why choose BIMx? Hyper-model feature. A unique technology that integrates 2D and 3D building project operations. Collaboration. Dissolves the gap between ideas from the studio to fieldwork in the construction site. Interactive platform. Users interact with 3D models in a responsive manner.</p>
7	<p>Archicad</p> <p>Overview ARCHICAD, another product developed by Graphisoft, is a 3D architectural BIM tool for design and modeling. Compatible with Mac and Windows desktops, it used by urban planners, architects, and designers to enhance their design workflow processes. Its CAD solutions are designed to cater to all aspects of the entire design process for the built environment including its engineering and aesthetics.</p> <p>Regarded as one of the first BIM implementations, ARCHICAD is a pioneer of CAD tools that have the capability of creating both 2D and 3D geometry. It is a complete design suite with various building information modeling and visualization functions to support the majority of the needs of architectural firms.</p> <p>USP's Why choose ARCHICAD? Algorithmic design. No gaps between early stage design and BIM.</p>

	<p>Open BIM. An open workflow that enables participation of project members regardless of the tool they use.</p> <p>MEP Modeler. Used for creating and editing 3D model-based MEP networks such as pipework and ductwork.</p>
8	<p>AECOSim Building Designer</p> <p>Overview One of Bentley System’s BIM offerings, AECOSim Building Designer, is a building design software system built to design, analyze, construct and manage infrastructures of any scale and type. It integrates with multiple disciplines ranging from architects to electrical, mechanical and structural engineers.</p> <p>With the emergence of Bentley’s new CONNECT generation, there have been major improvements in the tool’s in terms of interoperability, cloud capability, speed, mobile support, and connectivity. It has the ability to use mesh modeling and push/pull solid, for instance, to create a conceptual design and build parametric BIM content.</p> <p>USP’s Why choose AECOSim Building Designer? Multi-discipline solution. Built to enhance collaboration between architects and engineers with shared tools and workflows. Flexible design environment. Users are unrestricted from designing and modeling infrastructures no matter how complex. Building performance. Building simulation provides predictions of the real-world performance of the structure.</p>
9	<p>Trimble Connect</p> <p>Overview Trimble Connect is a cloud-based platform that specializes in connecting the right data to the right people at the right time. This solution is designed for architects, engineers, general contractors, subcontractors, and owner-operators. It brings people, technology, and information together to an environment that empowers collaboration.</p> <p>The tool is crucial for various phases of your workflows. For examples, you need a robust collaboration strategy for design coordination, lifecycle project management, and on-site and off-site communication. Since Trimble (company) acquired Tekla, the BIM tool mentioned above, this product also adds value to your Tekla solutions. Furthermore, it integrates with more than 50 industry tools to streamline your construction project workflows.</p> <p>USP’s Why choose Trimble Connect? Field layouts. A seamless passing of field layouts, 2D drawings and 3D models between the field and office. Connectivity. Specializes in connecting systems and a collaborative environment. Integrations. Robust integrations that work for various systems.</p>
10	<p>Hevacomp</p> <p>Overview</p>

	<p>Next on the list of best building information modeling software is Hevacomp which specializes as a building energy analysis solution. It has various products under its wing: Dynamic Simulation, Electrical Designer, and Mechanical Designer. This tool enables you to build energy-sufficient infrastructures through the prediction of accurate, real-world performances. As a product and company under Bentley Systems, it is a solution that is built to meet with United Kingdom standards.</p> <p>For instance, the Hevacomp Dynamic Simulation product enables you to design building simulations in compliance with the UK building regulations. It uses a single common building model for simulations and calculations to streamline the building analysis process.</p> <p>USP's Why choose Hevacomp? Building energy analysis. Conduct whole building energy simulations to help with design alternatives. Single model. It lets you use a common building model to minimize time spent on re-entering building data information. Weather database. Test an accurate energy simulation for more than 70,000 locations.</p>
11	<p>Procore</p> <p>Overview Procore is a construction management software with a user-centric approach that promotes collaboration between users and their clients in building products. The technology is intuitive and easy to use to support complex construction processes and streamline your team's workflow. It has fast time-to-value for users to be able to start using the tool immediately within weeks.</p> <p>It has four main modules: project management, construction financials, field productivity, and quality and safety. These products work together to ensure your project is developed successfully within your budget and deadline. The tool is built for professionals (architects, engineers, and construction managers), business owners, and contractors.</p> <p>USP's Why choose Procore? User-centric. Built by construction professionals for construction professionals, collaboration is streamlined between users and clients. Quick implementation. Unlike other solutions that take months, its deployment only takes weeks. Free, unlimited support. Customer support doesn't come at an additional cost for in-house support assistance.</p>
12	<p>SketchUp</p> <p>Overview SketchUp is a 3D modeling tool that is known for its ease of use. Without compromising functionality, this solution enables you to start drawing lines and shapes and then transforming them into 3D forms. It simplifies and accelerates your models by providing access to its free 3D models so you won't have to do each one from scratch.</p> <p>The product offers different products. It has a free 3D modeling tool you can access on your web browser. Next is the SketchUp Pro for a more intuitive solution in designing, documenting and transforming your ideas into 3D models. Finally, it has a tool for schools that is accessible in a browser for primary and secondary schools if they signed up for G Suite for Education.</p>

	<p>USP's Why choose SketchUp? Free module. It has a free tool offering in the web browser. Availability for everyone. It gives a wide range of users, from schools and educators to architects and game designers, access to 3D tools. Large 3D models repository. You can choose from its wide array of free 3D models.</p>
13	<p>Vectorworks Architect</p> <p>Overview Vectorworks Architect is a BIM and CAD designer solution package. Built to handle the design process, it is used for creating and modifying 2D and 3D models without hampering the creative process behind it. Its suite of tools enhances your design process and improves the entirety of your workflows—from conceptualization to construction.</p> <p>It has design-oriented capabilities, industry-leading BIM tools, and parametric objects to streamline the way you create a virtual prototype of your designs. It serves as an extension of the creative process, not a replacement, which helps designers explore more design options while supporting comprehensive construction documents and BIM models.</p> <p>USP's Why choose Vectorworks Architect? Design-oriented. It doesn't alter your design process while providing the same amount of functionality. Cross-platform graphical scripting. It opens more ways to explore form and function. Transformative geometry. Have the ability to create any shape with its NURBS-surface tools and Parasolid-based solids.</p>
14	<p>PriMus IFC</p> <p>Overview PriMus IFC is a platform for BIM Quantity Takeoff and estimating construction from BIM models. It is a tool that takes measurements from a 3D BIM model and automatically generates the relating bill of quantities. Various BIM 3D design solutions use this tool as a reference standard. It specializes in automating the acquisition of costs and project quantities from the 3D CAD or BIM model.</p> <p>This solution enables you to stay on top of your project's estimates. If there are any changes in the 3D BIM model, the system immediately updates the variations to correspond with the project costs and bill of quantities. Other features include assigning of price list management, automatic BIM model measurement, IFC file viewing.</p> <p>USP's Why choose PriMus IFC? IFC BIM Viewer. It uses the standard IFC file format when viewing BIM models and 3D CAD files. Construction estimate. The construction estimates are regularly updated in real time for any changes. Automatic BoQ. Bill of quantities is automatically generated from 3D models.</p>
15	<p>Edificius</p> <p>Overview</p>

	<p>If you are looking for an architectural BIM design platform, Edificius is a good tool to consider. This BIM solution is built to help you create a 3D architectural design in compliance with the latest regulations and in line with the newest technologies. In addition, it is an integrated solution that offers BIM for garden and landscape design, static rendering for photorealistic renders, and real-time rendering for animations.</p> <p>Furthermore, it has a real-time rendering engine and internal facilities. These features streamline cost estimating, structural engineering, and 3D design. Other features include 5D BIM to estimate project costs in real time, a catalog of free interior design resources, and a DWG and DXD CAD solution using elementary graphic entities.</p> <p>USP's Why choose Edificius? Parametric architectural objects. It automates the production of detailed construction documents with objects such as pillars, walls, and beams. BIM Objects Library. Thousands of free design resources are available for 2D CAD Blocks, HD textures, and 3D models. Photorealistic renderings. Advanced features for photo editing for realistic rendering.</p>
16	<p>BricsCAD BIM</p> <p>Overview Finally on this list of top building information modeling software, BricsCAD BIM is a complete BIM solution—from sketching to adding details to your designs—that help you develop a full-featured building information model. You have control over your the properties and elements you want to assign to your BIM, whether that’s multiple buildings or stories, for a start.</p> <p>Go into details by attaching information and compositions of building materials including definitions and layers to building elements. It also expedites and streamlines drawing generation. In a single click, you can generate a set of sheets, update them in sync, place elevation, and section or plan views, among others. Additionally, it has a smart structural modeling feature that recognizes linear solids for automatic classification.</p> <p>USP's Why choose BricsCAD BIM? Full design control. Create a BIM with zero limitations on elements and properties. Detail sections. Elevate construction documentation by adding detail sections of your model. “BIM Suggest.” An analysis of the connection between two building elements to refine the design.</p>
17	<p>midas Gen</p> <p>Overview midas Gen is one of the many products by midas, particularly for building engineering. It is an integrated BIM solution built for building and general structures. Engineers use this tool to perform structural analysis with a diverse range of specialty finite functions and modern theories to generate both practical and accurate results.</p> <p>It also streamlines designing complex and conventional structures with efficiency, versatility, and convenience. It has an intuitive modeling feature that uses similar CAD functions for drawing and</p>

	<p>creating nodes and elements. In addition to its user-friendly GUI, it also has a robust post-processor, auto-design features, and full analysis options.</p> <p>USP's Why choose midas Gen? Intuitive modeling. The Structure Wizard lets you readily create structures of regular patterns. Auto-design. Design check features are available for automatic designer and generation based on design codes. Dynamic post-processor. In accordance with specified design standards, it automatically creates load combinations.</p>
18	<p>Allplan Architecture</p> <p>Overview Allplan Architecture is a BIM solution for architects to gain control in the project and pave the way for creativity when it comes to designing and drawing. This universal tool for building design and construction helps you create professional drawings and visualizations, define physical and functional properties, and access reliable and accurate costs and quantities.</p> <p>You can use this tool to work completely on 3D or a combination of 2D and 3D. Furthermore, it enhances productivity with its modern and intuitive user interface that enables role- and task-based facilitation and quantity takeoff. The platform also ensures data exchange is smooth between planning partners, optimizes teamwork and collaboration, and follows precision in generating drawings.</p> <p>USP's Why choose Allplan Architecture? BIM-aided design. Virtually build designs first to spot errors during the early design phase to avoid construction conflicts. Design freedom. No limit on creating 3D models through integration with Parasolid modeling kernel from Siemens. Quantity Takeoff. 3D model-generated quantity takeoff for maximum reliability.</p>
19	<p>VisualARQ</p> <p>Overview VisualARQ is a flexible, on-premise BIM solution built to enhance the Rhinoceros 3D CAD application commonly used for architectural and industrial designs. It augments Rhino with additional tools for object styling and documentation tools that easily integrate with your workflow. VisualARQ specializes in freeform modeling that lets you convert any freeform geometry into precise, complex shapes that you can fill in with solids and other unique geometries. It also works with the Grasshopper visual program language within Rhino that allows you to create objects and object styles for building and modifying architectural objects.</p> <p>USP's Why choose VisualARQ? Integrated editor. Automates object and style creation. Dynamic documentation. Offers tools that auto lists native object information. Print 3D models in 2D view. Displays accurate 2D model image for paper presentations.</p>
20	<p>Buildertrend</p>

	<p>Overview Designed for home builders and remodelers, Buildertrend is a solution that focuses on construction project management. This cloud-based solution is a vital tool for staying on top of your construction project through a real-time, 24/7 access of construction scheduling, photos, documents, order changes, homebuyer selections, and warranty management, among others. With that, it is a popular choice for residential construction professionals. Buildertrend’s main solutions include pre-sale process, project management, financial tools, and customer management. Under each category is an array of features that range from plan markups (where you can annotate over blueprints) and scheduling to selections and budgets.</p> <p>USP’s Why choose Buildertrend? Connected platform. A cloud-based solution that empowers creativity on any device. Project management. Streamlined management of work on in the office and on the site. Plan mark up. With mobile access, you can annotate over the blueprint and view multiple version histories.</p>
	<p>Others:</p> <p>VisualARQ. A BIM solution for architectural designs and complementing Rhino platform. It adds a layer of objects styling and documentation features for more precise geometric shaping.</p> <p>TurboFloorPlan. A professional design interface that is also ideal for novice and small business. It has quick start tools, an instructional center, automatic cost estimator and green building tips.</p> <p>Softtech Spirit. An AEC modelling platform with built-in cost control feature and a suite of other BIM and CAD tools. It can integrate smoothly for cross-functional files such as IFC, DWF, STL, and DWG.</p> <p>Sefaira. A BIM platform for engineering, architectural and sustainability projects with novice-friendly tools for stage analyses, simulations and collaboration.</p> <p>CYPECAD. Primarily designed for analyzing reinforced concrete and steel structure for horizontal and vertical strength, this platform suits the needs of architects, engineers and construction firms. It also features integrated 3D structures via connection between CYPECAD and CYPE 3D.</p> <p>Archibus Building Operations Management. A building operations management module in the Archibus suite for streamlining management and monitoring processes in real estate, facility and infrastructure projects. It features self-service portal for schedule, report and dispatch tasks.</p> <p>OpenStudio. An open source building energy modeling designed by the U.S. Department of Energy, it is used for energy design and planning with advanced daylight analysis. It is capable of large-scale analysis utilizing tools like model input calibration, building stock analysis and design optimization.</p> <p>Revizto. It features a multidimensional issue tracking and collaboration hub to help teams to communicate and coordinate more efficiently across the project lifecycle, from inception, design, construction and up to operation. It makes tracking of building plans and adjustment easier and goal-oriented.</p> <p>Assemble Insight. It is a cloud construction data management that helps you condition, analyze, access and distribute model-based building data across pre-construction and construction processes. Key features include visual variance reporting, conceptual estimating, level of development tracking and export to Naviswork search sets.</p> <p>BIM Track. Ideal for BIM workflow coordination using a unified location for communication, data and issues. It helps you create 3D modeling, manage issues, visualize KPIs and receive alerts.</p>

	<p>SmartBIM Platform. Helps building product manufacturers share and manage BIM content with relevant parties such as engineers, architects and contractors. It's a highly collaborative platform that centralizes BIM data throughout the project cycle, from quote to completion.</p> <p>EcoDomus. A BIM platform designed for real estate owners, featuring a Common Data Environment that works with multiple formats. It allows for a cost-efficient way to implement maintenance procedures, specifically cutting on energy and labor costs.</p> <p>Innovaya. Helps streamline the entire design and project management process, adaptive to a variety of data modeling including AEC and Revit formats and provides a collaboration platform to share ideas, files and data.</p> <p>YouBIM. A BIM built for facilities management and works with multiple databases. Sporting a user-friendly interface, navigating its tools and locating data is easy, empowering office and field staff to adopt the platform with little friction.</p> <p>RhinoBIM. Built on the Rhino infrastructure, this BIM is a suite of plugins that expand Rhino 5.0 for AEC professionals. Among others, it has a structural design and editor, clash and clear analysis and BIM reporter.</p> <p>Onuma. An open-architecture BIM platform with standard tools for design, planning and management. It supports import/export of a variety of industry file formats.</p> <p>StreamBIM. A user-friendly BIM software that streamlines data sharing and collaboration. It focuses on the digitization of plans that are made accessible from desktop and mobile devices.</p>
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