TOPAs

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First Stakeholder Forum Report

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D8.2: First Stakeholder Forum Report

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Executive Summary

Deliverable 8.2 reports on the key findings of the TOPAs stakeholder fora held in Ireland & France on 25th February 2016 and 8th March 2016, respectively, as a means of engaging with the wider stakeholder community in order to better understand the needs of the potential TOPAs end user base, the energy management challenges they face and the ability of TOPAs to address such.

Keyword List

Stakeholder forum; empathy map; technical focus; strategic intent.

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D8.2 First Stakeholder Forum Report

1 Introduction

In order to reach the wider stakeholder community the TOPAs consortium organised two stakeholder fora to better understand the needs of the potential TOPAs end user base, the energy management challenges they face and the ability of TOPAs to address such. These fora were located at 2 of the TOPAs demonstration sites - the IBM Campus in Dublin, Ireland and the Galeo building in Issy-les-Moulineaux near Paris, France.

Broadly speaking the scope of both fora were similar i.e. investigate current energy management challenges and the ability of TOPAs to deliver a meaningful solution to such, with the Irish stakeholder forum targeting open building management system (BMS) approaches, auditing methodologies, energy performance modelling, energy challenges for Building Managers while the French Forum addressed air quality, energy performance modelling and energy management in practice.

The attendees were invited based on their relevance as potential end users of the TOPAs platform and constituent tools and services (in alignment with the relevant TOPAs project objectives) as shown in Table 1 below.

Table 1: TOPAs Project Objectives with respect to stakeholder categories

Objective	Stakeholder Category
#1 Open BMS: Develop an open platform that will efficiently analyse large amounts of data from building to blocks of buildings, including existing building management and metering systems.	Facility Manager, System Integrators, ESCO, Building Information Modelling
#2 Energy Prediction: Modelling approaches to accurately predict energy usage and close the gap between this and actual energy use through enhanced machine-learning approaches.	ESCO, Energy Modelling, Building Information Modelling, Semantics
#3 Model Predictive Control: with a continuous auditing methodology encapsulating live building performance measurements enabling a measurement based performance evaluation.	Facility Manager, ESCO, Energy Modelling
#4 Decision Support Tools & Services: for building and facilities managers, owners and ESCOs to more effectively manage their site, providing visibility on how energy related decisions impact cost, occupant comfort and health and general management process.	Facility Manager, ESCO, System Integrators
#5 Demonstration: TOPAs solution under real operating conditions.	Facility Manager, ESCO, System Integrators, Energy Modelling, Building Information Modelling, Semantics
#6 KPIs, EE Metrics, Methodologies: Enhance current common performance metrics and performance auditing processes for building and blocks of buildings	ESCO, Energy Modelling, Building Information Modelling, Semantics
#7 Gap Reduction: Target a reduction in the gap to 10% as an initial benchmark and to progressively challenge this target throughout the project.	Facility Manager, ESCO

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#8 Energy Savings: Additional energy savings in the region of 15% – 20%**.**	Facility Manager, ESCO, Government Body

This report will present each of the fora individually in the following sections and their outcomes.

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2 Irish Stakeholder Forum

The TOPAs Consortium (led by CIT, IBM & with participation from FHISE, ES and CEA) hosted the Irish Stakeholder Forum on Thursday 25th February, 2015 at the IBM Research Smarter Cities Technology Center, Dublin. The workshop was organised as an open discussion on the practical challenges, road blocks and solutions for building operation and energy assessment in order to deliver on energy sustainability in the built environment.

The aim of the workshop was to explore the challenges in minimising the gap between predicted and actual energy use. Specifically, addressing the topics of how to improve the understanding of post occupancy energy demand, and explore how modelling approaches can be used to quantify the performance gap.

In total twenty external stakeholders attended the forum with the breakdown per stakeholder category shown in Figure 1, with their relevance as potential end users of the TOPAs platform and constituent tools and services as shown in Table 1 above.

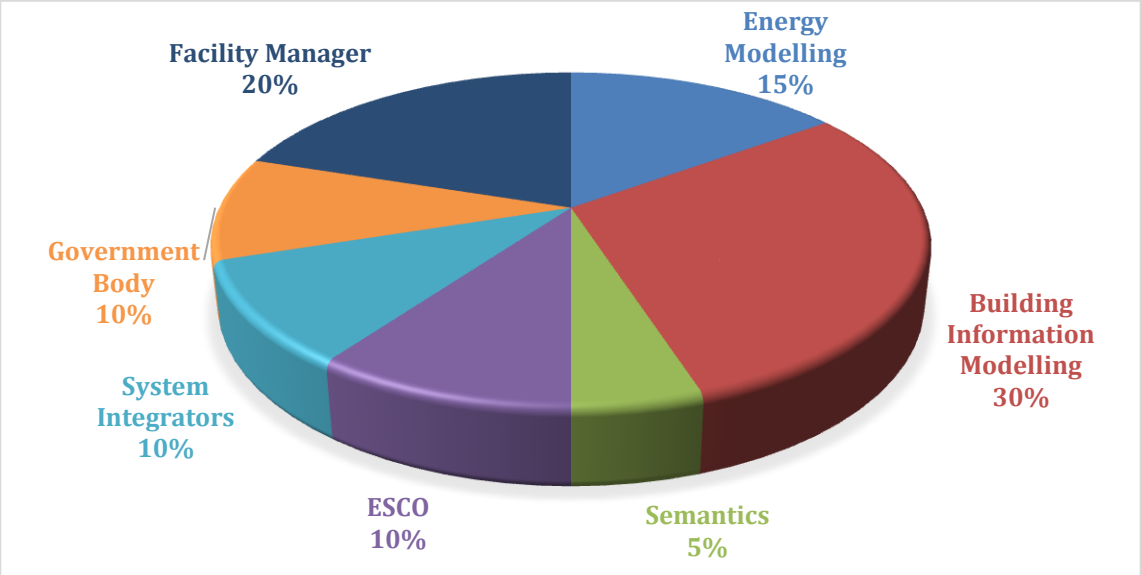

Figure 1: Stakeholder Category Breakdown

The workshop was structured in two parts with part one being a series of presentation talks (see Table 2) that firstly introduced the grand challenge of reducing the performance gap and introduced the TOPAs project as a whole and discussed the concept of an open BMS approach as being a potential solution for managing blocks of buildings. This was followed by a presentation on energy modelling and how this can be used as a measure to close the gap between predicted and actual energy use. The third session focused on policy and regulation in relation to energy management along with the need for awareness and incentivisation as means of energy management. Finally, this session concluded with a presentation discussing the practical challenges faced by building operators and facilities managers and the types of ongoing projects, measures being undertaken to address the energy management challenges also highlighting the need for an *automated* continuous auditing methodology, accurate quantitative analysis of predicted versus actual energy use as well as the need for tools and services to reduce administrative tasks with respect to capturing operational changes, usage patterns and periodic/fixed auditing schedules.

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Table 2: Irish Stakeholder Forum Presentations and Speakers

Title	Context	Speaker	Relevant TOPAs Objective
Open BMS Approach	TOPAs overview – minimising the gap between predicted & actual energy through cognitive buildings & an open BMS methodology.	Joern Ploennigs, IBM Research Ireland – **TOPAs**	#1 Open BMS
Energy Performance Modelling	Modelling approaches & challenges, the role of modelling in managing the gap.	Nicolas Rehault, FHISE - **TOPAs**	#2 Energy Prediction #3 Model Predictive Control
Unlocking the Energy Efficiency Opportunity	Techno-economic potential, energy opportunities, policy recommendations, raising awareness for personal gains through informed & engaged citizens.	Jim Scheer, Sustainable Energy Authority Ireland (Policy)	#6 KPIs, EE Metrics, Methodologies
Energy Management in the public sector - Real world Challenges	Real world experiences and conflict between policy, regulation, budget constraints & technology, trialling new energy management.	Michael Coughlan & David Hamilton, CIT (Building & Testbed Infrastructure Managers)	#4 Decision Support Tools & Services #7 - Gap Reduction #8 - Energy Savings

The second session was split in two round table discussion groups that addressed the following specific challenges relating to energy management:

1. Challenges for system integrators and building (facility) managers – Moderators D. Hamilton (CIT), Maxime Louvel (CEA), with reference to TOPAs objectives #1, #4, #7 & #8.
2. Challenges for energy assessment methodologies, metrics and models – Moderators A. McGibney (CIT), Fergal Purcell (ES), with reference to TOPAs objectives #2, #3 & #6.

Initially all members of the forum were given the opportunity to contribute to a brain storming exercise based utilising the empathy map approach as outlined in Section 2.1. Once all inputs were collected two groups were formed with an approximately evenly split and a mix among the various stakeholders in attendance in order to capture a broad spectrum of opinions for the

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specific challenge under discussion. Each group was assigned a moderator who summarised the findings in relation to the respective challenges.

The details and outcomes of these discussion groups with respect to TOPAs are presented in the Section 2.1 and 2.2 respectively.

2.1 Technical Focus

In order to capture the stakeholder feedback an empathy map, see Figure 2, was used for discussions relating to both Challenge 1 & 2. The empathy map was used to synthesize the stakeholder observations and to draw out any relevant insights in order to analyse the needs of the potential TOPAs user base and identify ways to improve or enhance the TOPAs offering if needs be.

Figure 2: TOPAs Stakeholder Forum Empathy Map

Stakeholder engagement was solicited based on the following categories in the empathy map:

- Internal - to understand their thinking and any fears, what is important?
- External - What is their attitude? What could they be telling others in the community? Are there any possible conflicts between what they say and what they think or feel internally?
- Pains – what are the current obstacles and challenges they come against?
- Gains – what potential solutions do they see, what do they want, how can roadblocks be overcome?

2.1.1 Empathy map outcomes - Challenges for system integrators and building (facility) managers

Under this challenge and in relation to an open BMS approach, the focus was on tools and services for continuous auditing, energy management and measurement. Table 3 represents a summary of the feedback garnered.

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Table 3: Empathy Map Summary - Challenges for System Integrators and Building (Facility) Managers

Internal	**View** Open does not mean free Open approach makes integration easier Administration overhead is reduced Single system of systems approach **Fear** High complexity – large variety of skillsets required Too much regulation because of large variety of interacting systems Who is ultimately responsible for an open systems approach
External	**Reality** Time/Monetary constraints Modelling/simulation takes considerable effort Integration effort for open BMS can be prohibitive, integration already a challenge As built system, what is actually deployed often greatly differs from what was planned **Requirements/Need to consider** Security Data privacy Independent performance verification Standards compliance **Opportunities** Open BMS offers comparison of actual versus expected performance Building lifecycle management Maintain communication flow between all building stakeholders
Pains	**Technology** Vendor lock-in at present Multiple technologies & associated standards – increasing complexity Manual system configuration typically used Closed systems System & domain silos Integration & capture of adaptive high fidelity data sets is an issue **Training/Skills** Steep learning curve Multiple skillsets required Multiple stakeholders (designers, integrators, facility managers…) Building operators/facility managers not well versed on BMS BMS Controls not easily accessible to building operators/facility managers

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	Data Clarity Limits on historical data Data transformation is often limited/difficult to do/extract Data reliability **Cost/ROI** Can be prohibitive – energy is cheap, difficult to secure senior management buy-in Value proposition must be more than energy Need clear demonstration of competitive advantage that can be achieved
Gains	**Success Measures** Capture overall energy savings rather than savings per system, capture interaction/effect systems have on each other Easily accessible data Open system - ease technology integration & reconfiguration Lower overall cost over life cycle **Standards** Guide common integration approaches Improve market uptake Bring stakeholders together – compliance **Policy & Regulation** Act as drivers – EU & National level Create market opportunities

2.1.2 Empathy map outcomes - Challenges for energy assessment methodologies, metrics and models

Under this challenge and in relation to energy and occupancy modelling and associated metrics, Table 4Table 3 represents a summary of the feedback garnered.

Table 4: Empathy Map Summary - Challenges for Energy Assessment Methodologies, Metrics and Models

Internal	**View** Cost versus carbon priority – need strong business case for investment Lack of focus on user comfort Require high levels/guarantees on data quality for modelling **Fear** Lack of skills to interpret data Requirements for substantial sub-metering infrastructure Energy management additional role for building operator

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External	**Reality** Air quality typically not considered Time constraints, limited/no resources to invest in energy management & modelling Energy management & modelling is a low priority What is the opportunity outside of energy – limited returns Benchmarks are typically outdated **Requirements/Need to consider** How to effectively engage with user How to solicit feedback and from whom What incentives can be used Training for personnel in relation to modelling Need independent verification, universal approach to energy management **Opportunities** Integration of utility data with building data Meaningful data based on accurate modelling rather than best guess/ad hoc predictions Develop meaningful KPIs related to actual building usage & performance
Pains	**Technology** Cross system coordination – i.e. conflicting goals, appropriate alarming where needed Continuous models that adapts to dynamics of the building Models need to be simple i.e. hide underlying complexity **Training/Skills** Modelling is expensive in terms of effort & skills Better internal communications regarding energy goals (financial & operations) Energy management needs to become part of maintenance process Requires a culture change, difference between “wanting” to “doing” **Data Clarity** Difficult to accurately capture energy savings with increasing staff/occupancy & usage patterns – changing baseline Need appropriate energy performance indicators to interpret/quantify data Correlation between varying data set resolution/granularity and how to understand user behaviour Independent verification required **Cost/ROI** Can be prohibitive – energy is cheap, difficult to secure senior management buy-in How to incentivise energy awareness to justify investment – energy is cheap

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	Energy business case models to secure buy-in Need to demonstrate ROI in 1-3 years Contractual – who pays
Gains	**Success Measures** Accurate empirical information Create win-win for all stakeholders – users in the loop Ability to link energy consumption to individual systems/zones Total lifecycle cost (CAPEX+OPEX) analysis Usage (energy) based charging **Policy & Regulation** Move beyond 2020 targets, need to address 2030-2040 targets Public sector targets are well defined but need similar for other sectors

2.2 Strategic Intent & Outcomes

Because TOPAs:

- has ambitious objectives
- wants to deliver business value to the TOPAs relevant market stakeholders
- is focusing on a market sector i.e. energy management that is wide and complex

We presented specific challenges relating to building management, system integration (BMS extensibility, data extraction), energy services (modelling, measurement, metering) as we wanted to understand the current views (*Internal, External*), pain points (*pains*) that the representative stakeholder body see as being obstacles and roadblocks to energy management and what they see as being potential solutions (*gains*) and where we see TOPAs as being able to deliver on these.

In relation to the TOPAs Open BMS approach as a platform for system integration the consensus among the stakeholders was that it offers a systems of systems solution that makes integration of heterogeneous systems easier, reduces administration in terms of managing multiple standalone systems and should be easily deployed across existing and new building blocks. In addition it brings with it the ability to accurately assess actual performance against predicted performance through continuous fined grained data extraction over standards compliant over secure data channels. But, this bring with it complexity in terms of the number of possible interacting systems, the skillsets required to deploy and operate such, as well issues relating to cost, contractual responsibility with multiple stakeholders being potentially involved in such a system of system approach where data privacy and security is a key requirement. However, this complexity is what TOPAs is addressing (see Table 5 for details).

In relation to energy modelling as mechanism for actively managing the actual performance versus the predicted performance the stakeholder consensus was that this is a key requirement in order to understand system behaviour and interaction. Continuously updating models based on real data allows for accurate representation of predicated performance based on the real operating conditions of the building. Having a continuous near realtime view of system performance allows for the development of meaningful KPIs to quantify energy usage over multiple time scales and changing baselines. Air quality was an issue raised by stakeholders as being one that is typically overlooked unless it is in reference to acute environments or pharma areas and was flagged as being important in holistically managing the built environment, with air

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quality being explicitly explored in the French Stakeholder Forum presented in Section 3. While the benefits of modelling were appreciated in managing energy a concern was that it is an intensive exercise requiring significant knowledge and data and brings with it a cost that can, like system integration, be prohibitive. While energy is perceived as being cheap the costs for the roll out of energy management solutions is often excessive making it difficult to secure financing, meaning that we need to look at the current and alternative business models in this sector, and was explored as part of the French Stakeholder Forum presented in Section 3. Another concern/interest expressed among stakeholders was how to effectively engage the user and how to incentivise energy awareness on an ongoing basis. While the focus of TOPAs is not on investigating user behaviour and incentivisation we will however investigate the development of appropriate HMI mechanisms for building managers in order to develop a tool for effective building asset management.

The pain points identified under both challenges (listed under Technology, Training/Skills, Data Clarity & Cost/ROI in Table 3 & Table 4 represent the stakeholder view of the current obstacles to energy management. Table 5 identifies these pain points as a summary of the key priority areas across both challenges (Key Priority Challenges - *Pains*) that need to be addressed to support the stakeholder industry needs in achieving sustainable energy savings across buildings with reference to the TOPAs innovation that will contribute to addressing these challenges (TOPAs Target - *Gains*).

Table 5: Summary of the Key Priorities that need to be addressed

#	Key Priority Challenges - *Pains*	Addressed by TOPAs	TOPAs Target - *Gains*
1	**Technology:** Currently systems are closed and use multiple protocols that form data silos in buildings and controls that are inaccessible.	a) Installation and secure integration of existing BMS via a (re)configurable hardware/software platform that encapsulates re-usable multi-protocol data connectors. b) Open interfaces both for north bound (business applications) and south bound (systems control and operation).	Open BMS- Open system to ease technology integration & reconfiguration, District, Building & zone level data extraction
2	**Training/Skills**	The creation of a development cookbook to make it easier: a) For system integrators setup & configure BMS systems. b) Building managers to integrate across multiple systems.	Improved workflow process Guide common integration approaches Improve market uptake Bring stakeholders

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			together – compliance
3	**Data Clarity:** Coordinating and interpreting data from multiple systems is a difficult	a) Open interfaces following the IoT paradigm making data access easy and accessible. b) Creation of boiler plate control and analytic services that can be used across buildings. c) Data Management processes to ensure data quality and stream processing. d) Using user centred design methodologies. TOPAs will develop a HMI design to promote sustainable energy savings for building stakeholders.	Accurate and Relevant Data access Transform Data to Insights
4	**Cost/ROI**: System and Data Integration, Modelling, Energy Management and Maintenance can be prohibitive	Integrated tools and services to reduce the effort associated with: c) Installation and secure integration of existing BMS via a (re)configurable hardware/software platform that encapsulates re-usable multi-protocol data connectors and open interfaces. d) Development of composable energy model - black box and white box. e) Distributed Model Predictive Control allows for easier creation of localised controls in comparison to centralised control development. f) Use of reusable fault detection and diagnosis techniques that can be applied to varying building systems.	Maximise ROI Capture overall energy savings rather than savings per system, capture interaction/effect systems have on each other Offer support for total lifecycle cost (CAPEX+OPEX) analysis Could potentially support usage (energy) based charging

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3 French Stakeholder Forum

The TOPAs Consortium (led by CEA, EMBIX, FHISE and AZIMUT) hosted the French Stakeholder forum on Tuesday 8th March, 2016 in Issy-les-Moulineaux, near Paris, France. This forum has been an opportunity for TOPAs to present its approach and rationale to minimize the gap between predicted and actual energy use, in relation to continuous auditing. This forum allowed open discussions and facilitated engagement between stakeholders in identifying potential solutions to the energy challenges faced by them across various market sectors.

This one day forum provided attendees with new insights on innovative building energy management and supervision methods. Invited participants included ESCOs, Air Quality companies, building developers, building managers and system integrators. This brought together a unique forum of experts to provide feedback on the TOPAs direction. Feedback from the experts will help the TOPAs consortium to better understand the needs of its potential customers, to improve its business model offering and to address the current energy management challenges of actors present in the market.

In total six external stakeholders attended the forum with the breakdown per stakeholder category shown in Table 6Figure 1. The attendees were invited based on their relevance as potential end users of the TOPAs platform and constituent tools and services (in alignment with the relevant TOPAs project objectives).

Table 6: Stakeholder Category Breakdown

Company	Activity	Stakeholder category
Camfil	Air filters	Air Quality
EDF R&D	Building efficiency, air quality, ventilation	ESCO
Bouygues Energy & Services	New services for buildings and districts	ESCO
Bouygues Immobilier	Measuring and warrantying the performance of buildings	Property Development
CEA, Bag'era	Middleware	System Integrator
Nobatek	Energy efficiency in buildings	ESCO

The forum was organised in two sessions, during the first session, the TOPAs consortium presented the TOPAs project as a whole and its vision on the main challenges for energy efficiency in buildings. After the introduction to the project objectives, attendees were given a series of presentation talks by the TOPAs partners on the current challenges in Air Quality, Energy Performance Modelling and Industrial Deployment of Energy Management Solutions (cf Table 7 below).

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Table 7: French Stakeholder Forum Presentations and Speakers

Title	Context	Speaker	Relevant TOPAs Objective
Air Quality Management	Current challenges of air quality monitoring and management, link with TOPAs and deployment strategy	Benoît Plassat, Azimut – **TOPAs**	#4 Decision Support Tools & Services #6 KPIs, EE Metrics, Methodologies
Energy Performance Modelling	Modelling approaches & challenges, the role of modelling in managing the gap.	Nicolas Réhault, FHISE - **TOPAs**	#2 Energy Prediction #3 Model Predictive Control #7 - Gap Reduction
Industrial deployment of Energy Management Solutions	Real world experiences and conflict between policy, regulation, budget constraints & technology, examples at the district scale	Alexandre Capelle, EMBIX - **TOPAs**	#1 Open BMS #4 Decision Support Tools & Services #5 Demonstration #8 - Energy Savings

The second session was organised as round table discussions in order to encourage the participants to share their views regarding the new building energy performance supervision methods that TOPAs aims to develop, and to explore the opportunities for these in addressing their energy sustainability needs. The discussions were mainly oriented towards identifying the stakeholders' needs and the pertinence of continuous auditing.

The details and outcomes of these discussion groups with respect to TOPAs are presented in Section 3.1 and 3.2 respectively.

The French Stakeholders Forum ended with a short visit to the Galeo building, headquarters of Bouygues Immobilier and a demonstration site for TOPAs. During this visit, the HVAC system of the building was presented to the participants, as well as the Air Quality equipment and monitoring systems installed at the site.

3.1 Technical Focus

In order to capture the stakeholder feedback an empathy map, see Table 8: Empathy Map SummaryTable 8: Empathy Map Summary below (based on Figure 2: TOPAs Stakeholder Forum Empathy Map), was used to capture the stakeholder observations and solicit relevant insights in order to analyse the needs of the potential TOPAs user base and identify ways to improve or enhance the TOPAs offering if needs be, as was done in the Irish Forum.

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Table 8: Empathy Map Summary

Internal	**View** Strong need to correlate energy consumption with air quality It is also important to focus on the occupant comfort, rather than only on reducing the energy consumption Value proposition must be more than energy Continuous auditing is needed to go further than just corrective actions Enhancing the occupant comfort actually has a return on investment TOPAs-like systems are needed for new buildings in order to hold and warranty the commitments of performance in the long term Building Automation Systems have to transition to Energy Management Systems
	Fear Energy may not be expensive enough to justify such technology Technology push vs. Market pull Need clear demonstration of competitive advantage that can be achieved Facility managers already have some simulation and fault detection tools Can we show AQ data to the occupants or the politics/public? (especially if it's not good) The market is not designed for a continuous auditing process (it's based on build, observe, fix, observe, fix, … with long period of time between the phases) What is the cost of TOPAs?
External	**Reality** Time/Monetary constraints Facility managers offering is becoming more and more global Facility managers are paid on the basis of a reduction of the energy consumption, therefore the first year if often over-evaluated Only 10% of facility managers have energy performance contracts Not clear who would pay for TOPAs, FM? ESCOs? Property developers can't warranty the performance of their buildings in the operational phase
	Requirements/Need to consider

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	Building Information Models (BIM) Monitoring and control of AQ in order to reduce the energy consumption Serious gaming approach Demand response for grid optimization How to integrate TOPAs in a retrofit? Billing in the case of several occupants : energy rather than surface **Opportunities** Energy Efficiency Certificates Energy Performance Diagnosis (mandatory if more than 250 employees, unless ISO 50001) Energy Performance contracts New labels have AQ targets Two AQ tests every year (~6000 € each) for HQE buildings, to reschedule if the test is failed
Pains	**Technology** Accuracy of simulation/prediction models Integration of tools into something comprehensive No agreement today on the best Air Quality KPIs Taking the occupant's comfort into account **Training/Skills** Use of multiple separate tools Appropriation of tools by the user **Data** Data reliability & privacy **Contractual** Who pays? Who operates? How is the ROI redistributed? If TOPAs actually controls (DMPC) the energy in a building, who is responsible for potential deviations?
Gains	**Success Measures** Comfort-driven energy optimization Energy savings

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Easy and immediate detection of deviations
Sustainable business model and contractual structuring
Easy to interface solution
Continuous verification rather than repetitive unwieldy audits

3.2 Strategic Intent & Outcomes

Throughout the open discussion with the stakeholders focused on two topics. The first topic was the potential TOPAs clients and how would they benefit from TOPAs. The second topic was the business model of TOPAs.

3.2.1 TOPAs clients

The main question is who is/are the best target(s) of TOPAs. Several actors have been identified in the forum, with some pros and cons for each of them:

- Facility managers:
  - Pros: Only 10% of FM currently have energy in their contracts, why would the other be interested by TOPAs?
  - Cons: Integrating IAQ and user comfort could be something new and valuable for FM:
    - They could claim to handle it
    - New labels could be built to move the market in this direction
- Building owners:
  - Pros: In France (and Ireland) it is mandatory[1] for companies of more than 250 employees to do energy audits, unless they have the ISO 50001 standard (which requires to improve the energy management system and the resulting energy performance). TOPAs could help get this certification, and thus enable the participation of the building to the energy savings certificate market.
  - Pros: A continuous audit of the buildings could be useful when selling them.
  - Pros: Integrating IAQ and user comfort could increase the rent
- Building occupants:
  - Cons: They are the key target for the comfort but they do not pay, how to close this gap?
- ESCOs:
  - Pros: TOPAs could provide a deeper knowledge on the energy performance
  - Pros: TOPAs could automate the energy analysis and thus decrease ESCOs costs
- Building developers:
  - Pros: New models are built to pay a bonus to developers if their buildings meet the energy performance target. TOPAs could be used to validate these targets
  - Pros: TOPAs could bring the tradeoff between energy and comfort

[1] http://www.developpement-durable.gouv.fr/Audit-energetique-reglementaire,41540.html

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- Pros: TOPAs could be a selling argument: a TOPAs compliant building would ensure a better IAQ, user comfort while minimizing the energy consumption

3.2.2 Business clarifications

During the discussions, several concerns have been raised that could limit the impact of TOPAs and should be taken into consideration for the TOPAs Business Model:

- The continuous auditing approach is very attractive but it changes drastically how the building business is working. Current cycles are roughly of a year between measurements and actions. Today's market is designed for that. However, a goal for TOPAs is to investigate new business models for ESCOs in this market space with the likes of ISO 50001 pushing for ongoing energy management. The Open BMS and continuous auditing approach can offer new business opportunities and brings with it the possibility of evolving the market to react to such. TOPAs is addressing these future challenges and will need to look at who will be impacted (positively and negatively) by this approach.
- European regulations are opportunities, however they do not seem to be applied yet.

3.2.3 Key Priorities to Address in the Project

Table 9 identifies the pain points as a summary of the key priority areas identified (Key Priority Challenges - *Pains*) that TOPAs must address in order to satisfy industry wants in the area of sustainable energy management and identifies the TOPAs innovations that will contribute to addressing these wants (TOPAs Target - *Gains*).

Table 9: Summary of the Key Priorities that need to be addressed

#	Key Priority Challenges - *Pains*	Addressed by TOPAs	TOPAs Target - *Gains*
1	**Technology:** Accuracy of prediction models and integration of tools into a cohesive solution, making the occupant comfort a priority	a) Definition of the architecture, interfaces, protocols and a common data format for a scalable integrated platform deployed at multiple building blocks b) Development of models to predict performance, encapsulating Energy, Indoor Air Quality, Occupants behaviour and Equipment Effectiveness, integrating comfort as an optimisation parameter. c) DMPC with Air Quality constraints	Open BMS- Open system to ease technology integration & reconfiguration Better AQ indicators and performance prediction
2	**Training/Skills**	The creation of a development cookbook to make it easier: a) for system integrators setup &	Improved workflow process Guide common

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		configure BMS systems b) Building managers to integrate across multiple systems	integration approaches Improve market uptake Bring stakeholders together – compliance
3	**Data:** Data reliability & privacy	a) Autonomous fault detection and diagnostics methods for building systems based on data-driven diagnosis models b) Ethics management plan – Ensuring no personal data is collected and management of sensible data	Detection of performance deviations and unexpected values Respect of the occupant's privacy and security
4	**Contractual**: Cost/ROI What is the business model?	a) Scalable, Cost-effective Management infrastructure for buildings b) DMPC with variable pricing c) Energy savings via DMPC and Fault Detection Diagnosis d) The development of a new business model for the TOPAs tools will be carried out during the course of the project	Maximise ROI Cost-effective solution Sustainable business and contractual models

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4 Conclusion

The aims of these fora was to introduce the TOPAs project and approach to address holistic energy management for blocks of buildings and to specifically address system integration, energy modelling, role of air quality in energy management and business models. These fora provided TOPAS with the opportunity to engage the broader stakeholder community in an effort to better understand the needs of the potential TOPAs end user base, the energy management challenges they face and the ability of TOPAs to address such. Based on the outcomes of both events (as presented in Sections 2.2 and 3.2 we can surmise that TOPAs is addressing real industry needs in terms of developing an open BMS approach to support system integration, dynamic modelling techniques, air quality driven energy management and investigating appropriate business models for this systems of systems approach to energy management.

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