

THE SOCIAL COMPONENT OF BUILDING PERFORMANCE SIMULATION *UNDERSTANDING ARCHITECTS*

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ABSTRACT

Building performance simulations (BPS) have a significant potential in informing architects' design decisions. However, architects seldom consider BPS as an integral element of their design processes. This paper reports on a combined qualitative-quantitative methodology aimed at exploring socio-cultural; non-technical barriers discouraging BPS integration; from UK architects' perspectives. A storyline of phenomena consisting of three levels; **architects' professional identities, attitudes towards BPS and collaboration with BPS specialists**, is deduced using a grounded theory-inspired coding procedure. These are validated by way of descriptive statistics and frequencies from a quantitative follow-up. The paper concludes that long-term solutions, addressing differences in professional paradigms, are required rather than rapid response software-level and/or interface improvements.

INTRODUCTION

Advantages of building performance simulations (BPS) in architectural design have been widely discussed in previous literature (Capeluto, 2011; Bambardekar, and Poerschke, 2009; Morbitzer, 2003). Design decisions concerned with parameters such as building orientation, form, spatial layout, wall-to-window ratio and materials, all considerably impact on building performance in post-occupancy evaluations (CIBSE, 1998). These decisions tend to lie strictly within the realm of architects' decision-making.

Yet many architects rely on conceptual ideologies and abstract rules of thumb to make these decisions. Designers continually resort to their traditional design methodologies, and reserve BPS calculations as final performance checks, compliance confirmations or altogether rule them out of the design process. On the other hand, BPS conducted as a continually-integrated element of the design process, promises a calculation-based, quantifiable approach to validate design decisions.

A large number of BPS interfaces aimed at architectural-use have been created (Gratia and De Herde, 2002; Mourshed et al, 2003; Reither and Butler, 2008). This list is not exhaustive; its purpose is to demonstrate the advances made in this field. Nevertheless, research shows that architects'

uptake of BPS remains comparatively low (Attia and De Herde, 2011). In most cases where performance checks are required, architects will join forces with BPS specialists; in a collaborative effort towards integration (MacDonald et al., 2005).

Investigated reasons offered for poor integration usually revolve around the tools. New software-level solutions are often discredited with having non-visual interfaces, time-consumption, large input requirements, steep learning curves; amongst others (Attia et al., 2009).

This paper argues that software-level contributions alone, based on assumptions of the architectural world, are unlikely to increase architects' uptake of BPS within their practices. It is potentially a set of **non-technical, socio-cultural barriers** that prevent architects from integrating BPS. Architects tend to have different backgrounds and knowledge processing methods to tool-creators (Attia et al., 2009), who are predominantly engineers and building physicists; the latter professionals with little knowledge and interest in human-computer interaction processes (Mahdavi, 2011).

Similarly, in a joint collaborative effort between practitioners of heterogeneous backgrounds, socio-cultural differences may also inhibit understandings and reduce potential benefits of collaboration. Again, BPS specialists here tend to be building services engineers, mechanical engineers or building physicists; i.e. professionals with varying experiences and a myriad of understandings of building design and working aspirations. Collaboration which does not occur on a singular foundation of understanding, which both parties can relate to, can lead to conflict (Kalay, 2001).

In both cases, there is a comfortable isolation of architects and BPS specialists in the building industry; both of whom can no longer afford to be absent from each other. Architects and BPS specialists in the building industry must interact with each other to achieve the holistic designs which are nowadays much aspired for in the

building industry. Yet, a harmonious and orchestrated synthesis will never be realisable while either architects or BPS specialists each remain in their own respective worlds; only observing the granularities of their specialisations. A plethora of complex, interrelated tensions; beyond the level of the software; need to be recognised as possible hindrances to integration, by members of the two worlds.

With this argument in mind, we invite you to understand some **attitudes, values and experiences voiced by architects**, and the implications these may have towards adopting BPS. While the authors realise that the work presented in this paper lies on the periphery of this conference themes, it departs from the vantage point encouraged in (Mahdavi, 2011)'s keynote publication.

Rather than aspiring to find an absolute panacea to integration; the purpose of this paper is to conduct an in-depth exploration of architectural users. It is aimed at providing a creative and insightful construction of the professional culture; and underling phenomena which may be discouraging them from integrating BPS in their design practices. Once such insights have been exposed; it is likely that contributions which are more responsive and sensitive to their characteristics, opinions and work requirements can be made.

This article reports on interim findings from an on-going PhD project comparing the worldviews of architects and BPS specialists. It is not the intention of the authors to cover *all* potential socio-cultural barriers that prevent BPS integration. Due to spatial restrictions of this paper, only a selected few, from the architects' perspectives, are presented and questioned here. Nevertheless, this does not exclude that more socio-cultural barriers are present; both on the side of the architect and the BPS specialists as well.

EXPERIMENT – RESEARCH METHODOLOGY

The chosen methodological approach for this research consists of two phases:

a) **The Qualitative Phase:** Grounded Theory is the overarching constructivist approach; used to develop an inductively-derived theory about a phenomenon; 'grounded' firmly in the data (Strauss

and Corbin, 1990). It subscribes to an open-ended approach of cyclical data-collection, interpretation and validation. Interpretations made do not stand unchallenged. Rather, they are grounded in subsequent testing and questioning. This process finally results in a slow emergence of insights.

Data was constructed through a series of semi-structured interviews with architects working in practices located in England and Wales. A combination of non-probability purposive sampling and snowball sampling were used to recruit interviewees into this phase of the study. In total, ten interviews were conducted in four months.

Semi-structured interviewing was chosen for its provision of worldviews, interpretations, understandings and opinions of BPS. Interviewing is particularly attractive for exploration of voices which may have gone unheard or have been misrepresented in previous research. This is particularly applicable in the field of BPS; where socio-cultural, non-technical barriers to BPS integration tend to go overlooked.

While a thematic interview guide was created, most interview questions were improvisational and open-ended. These were intended to elicit elaborate accounts and reflections on interviewees' career trajectories and experiences; and opinions voiced in reflection. Thematic insights could then be extracted from these accounts in the analysis and coding phase. Thus, all qualitative insights discussed in the subsequent section represent unbounded perceptions of interviewees **in their own words, uninterrupted by the interviewer**; rather than direct responses gained from closed-ended 'question-and-answer' sessions.

The duration of each interview ranged between one and one-and-a-half hours. Each conversation was audio-recorded and transcribed promptly afterwards.

Data-analysis followed the rigorous procedural set of instructions in Strauss and Corbin (1990). This provides a detailed set of guidelines for 'coding;' the term used in qualitative tradition to describe the analytical procedure.

The first stage, 'open coding' involved assigning labels to abstract concepts found in the data. Transcripts were broken down into short data-segments, each centred around a loosely identifiable theme. The second stage, 'axial coding,' involved grouping concepts into empirically-derived categories. At this stage,

relationships between categories could be established.

The third and final level of analysis, ‘selective coding,’ involved integration of the aforementioned concepts and categories into a **central storyline** of phenomena. In order to complete this stage of coding, interpretations made were validated by way of a quantitative survey.

b) The Quantitative Phase: An online questionnaire was designed for validation of extrapolated phenomena. Opinions gathered from the interviews and interpretations made were predominantly presented in a Likert-style format; to question the degree to which the wider architectural community agreed or disagreed with the qualitative phenomena.

The questionnaire was put on the World Wide Web; at the domain: <https://www.surveymonkey.com/s/WZMWY5G>. The RIBA Directory of Chartered Members (<https://members.architecture.com/directory/default.asp?dir=3>) was used to build a sample size of 500 practitioners in England and Wales. The questionnaire yielded a total response of 175 respondents.

The focus of this paper is on the qualitative interpretations, which provide valuable insights into the unexplored and unresolved concerns of practising architects.’ Due to spatial restrictions, results of the quantitative study are only reported on using descriptive statistics and frequencies. These are used to satisfy the objective of generalisation; and to see whether the quantitative data affirms or denies qualitative interpretations.

DISCUSSION AND RESULTS:

The storyline of phenomena yielded from the above-described methodology are presented in figure 1. In the discussion, each phenomenon is explored individually as a single qualitative insight. Each insight is collated and described using original quotations from the interviews. Those requiring further generalisation are followed-up with statistical confirmations from the survey. The conclusive outcome of each insight informs the following one, until phenomena are linked together by way of intermediate cause-and-effect relationships. Thus a complete story of all three levels of phenomena is constructed.

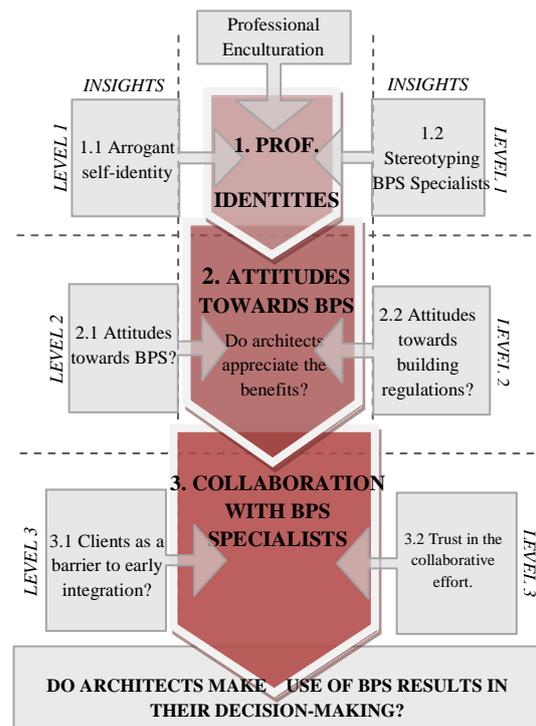


Figure 1: Storyline of phenomena discussed in the following sections.

LEVEL 1: PROFESSIONAL IDENTITIES

Understanding architects’ professional enculturation is a necessary foundation to realising their attitudes towards BPS. Furthermore, understanding their professional identities; formed as a result of enculturation, helps us to appreciate behaviours which may arise when collaborating with BPS specialists, i.e. members of a different professional group.

Architects’ professional identities are initially negotiated during training. Apart from gaining basic knowledge and skills, they begin to acquire the architect’s way of thinking; and professional identity. Within this identity lies a constellation of attributes, beliefs and values architects typically use to define themselves.

Meanwhile, part of identity construction occurs by exclusion of others; whose identities do not conform to the same set of standards used to define one’s own, and who do not partake in the same activities. Little or no training in BPS in architectural education means it does not include within this identity-definition. Conventionally, architects begin to believe that BPS lies outside the realm of their professional activities.

As BPS is seen to lie outside architectural boundaries, architects’ attitudes and behaviours may convey a particular aversion to it; indirectly impacting on integration in the design process. Two

particular ones; **arrogant self-identity** and **stereotyping BPS specialists**, surface within the interview data, which are worthy of discussion.

Arrogant self-identity - Qualitative Insight 1.1:

This characteristic featured repetitively within the interview data. The following quotes indicate this self-image:

*“I think to a certain degree it’s true; architects are **arrogant**.”*

*“People think that architects are **arrogant** because they’re constantly challenging and asking questions.”*

*“The higher the [architect’s position], or the more famous the practice [is], the more **arrogant**” professionals are likely to be.*

Architects’ arrogant attitudes may be attributed to the historical position of the profession; which has primarily been associated with the rich and ruling (Barrow, 2004). The architect’s position was at the forefront and, as interviewee 3 offers, *“historically...it was all about the architect making the decisions.”*

An elitist profession evolved; and it is not surprising that a corresponding demeanour has been passed down through professional enculturation. Interviewee 5 blames architectural schools’ emphasis on philosophical thinking over technical robustness of the design product. They *“think they can get away more and more and more with lack of teaching...technical stuff. And they do it in a way of making it seem like it’s not a trendy thing to do... ‘somehow we’re architecturally superior if they just teach students how to talk the philosophical talk.”*

Moreover, arrogance may be a way of compensating for architects’ previously celebrated status; which is currently being ‘eroded’ (Hamza and Greenwood, 2009); as design decision-making is taken over by BPS specialists who have accessibility to state-of-the-art technologies. This is not solely a physical accessibility; technologies are often within architects’ proximity. However, non-architectural specialists are empowered with background understandings to operate them.

Conversely, currently-practicing architects are unlikely to have a comparable knowledge. The authors therefore speculate that technology has transferred power into non-architectural hands. It is possible that an arrogant temperament; and *“egos”*

as described in one of the interviews, may be used by architects to recover some power.

Conclusive outcome: Arrogant self-identity may have a hindering effect on integrating BPS in the architectural design process; in three possible ways:

1. As a result of professional enculturation and lack of training in BPS, practising architects may believe that simulations lie beneath the realm of their elitist design practices, and refuse to abide by BPS results and recommendations as a matter of principle.
2. In line with their professional identities, they possibly feel that BPS does not fall within the boundaries of architectural work, and are averse to validating their design decisions by way of BPS.
3. In collaboration with BPS specialists and consultants, a visibly arrogant disposition is likely to have a negative impact on the working relationship between building professionals.

Stereotyping BPS specialists - Qualitative Insight 1.2:

Architects’ use of stereotyping is mentioned in the interview data as follows:

*“You only have to look at the **stereotypical architect**...you just have to go in the shop over there [RIBA Bookshop] and...she came out looking pretty cool. Do you know what I mean? **If you went into the CIBSE, for example, you’d get a different type of people.**”*

Stereotyping forms a standardised and simplistic cognitive mechanism of grouping all members of the same social group; whereby they are all perceived to have the same set of characteristics. Stereotypes profoundly bias how information about the stereotyped other is sought out, attended to, interpreted and remembered.

Whether architects stereotype BPS specialists’ ideologies, practices and working methods is further questioned in the second research phase. 84.2% of participants responded with ‘yes’ or ‘sometimes;’ architects do stereotype about BPS specialists. Further elaboration to the natures of respondents’ stereotypical impressions are categorically ranked and grouped in Table 1.

It is likely that stereotyping impedes BPS integration. When architects stereotype about BPS specialists, they build impressions based on prejudicial thinking and false assumptions.

Table 1: Categorical ranking of stereotypical impressions architects have towards BPS specialists.

STEREOTYPICAL IMPRESSION	%
Number-crunchers/data-specific/data-‘inputters’	17.89
Inflexible; narrow-minded	13
‘Boffins’	12.2
Do not understand building design/not interested in building design.	11.4
A ‘rivalry’ situation – architects vs. BPS specialists	9.7
Uncreative/linear thinking	8.94
No view/don’t know	6.5
Un-holistic	4.01
A regulatory requirement	3.25
Uninterested in aesthetics	3.25
A necessity	2.44
‘Box-tickers’	2.44
Lazy	1.63
Bureaucratic	0.81
Time-consuming	0.81
Assistive role	0.81
Realists	0.81

Conclusive outcome: These potentially threaten the collaborative effort in the following ways:

1. It is likely to inhibit mutual understandings: prejudicial assumptions mean that architects deal with BPS specialists based on their perceptions of the others’ aims in the collaborative effort. These may differ greatly from the actual aims.
2. Biased beliefs in the aims, intentions and values of BPS specialists are also likely to increase negativity in architects’ **attitudes** towards the process of BPS. This is discussed in the following sub-section.
3. It is likely to reduce trust between the two collaborating sets of professionals; particularly intuitive trust. Intuitive trust is elaborated upon in the last qualitative insight discussed in this paper.
4. Consequently, negative behavioural reactions are likely to arise; on both sides of the collaborative effort. Interviewee 1 reinforces this; saying, “*there tends to be a certain amount of mickey-taking between architects and [BPS] engineers,*” as a result of stereotyping.

LEVEL 2: ATTITUDES TOWARDS BPS

Formation of attitudes towards BPS can be attributed to professional enculturation and identity. Attitudes can be either positive or negative evaluations of an attitude object. Attitudes which are unique within a group are ascribed as ‘social attitudes’ or values. The interview data reveals that, amongst architects, both appreciative and unappreciative attitudes of BPS can be found.

Attitudes towards BPS: Appreciative and unappreciative - Qualitative Insight 2.1:

Appreciative attitudes can be summarised as follows:

- **‘Early decision-making:’** Interviewee 5 demonstrates the understanding that BPS promises, “*to help designers make the right kind of early decisions like where to place their buildings, how to orient them, what the depth of plan should be, percentage of glazing, what the mix of renewables might be or other sources of energy and so on.*”
- **‘To Quantify:’** Interviewee 4 acknowledged that the need to conduct BPS is “*to quantify*” energy efficiency and building performance.
- **‘Technological aspects:’** Interviewee 1 highlights the view that BPS helps designers, “*to understand how the technological aspects of your building are going to come together before you start applying for planning.*”

Unappreciative attitudes:

It is likely that the architects who are unable to convey an appreciation of BPS benefits cannot recognise them due to what Mahdavi (1998) describes as “*the elitist approach.*” User-unfriendliness and steep learning curves can make it difficult for architects to understand the potential benefits BPS has to offer. The following quotes demonstrate some unappreciative attitudes interviewed architects hold towards BPS:

- **A paperwork exercise:** Interviewee 3 finds BPS too bureaucratic, tedious and rigid. He repeatedly described it as, “*the paperwork exercise,*” which he feels, “*sometimes...detracts from what real architecture is about.*”
- **Black box/ black art:** In some cases architects perceive BPS calculation engines as obscure systems of which they have little or no understanding of its internal working process. The following quote indicates this; “*heat-loss models and things like that; it’s a black art to me. It’s like being in the front row of a scrum; in rugby. You know stuff’s going on, but you don’t know what’s happening.*”

The aforementioned appreciative and unappreciative attitudes are tested further in the quantitative phase. Figure 2 illustrates that architects agree with the expressed appreciate

attitudes but also some of the unappreciative ones. The attitude that is met with most agreement is the last one; ‘BPS is often done for the sole purpose of compliance.’

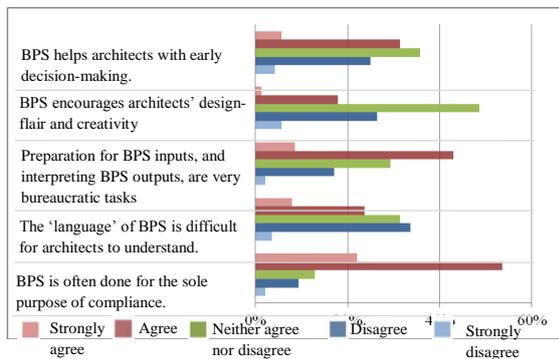


Figure 2: Architects' attitudes towards BPS.

Conclusive outcome: Few appreciative attitudes are crudely and elusively expressed. BPS promises many more benefits than ‘early decision-making, quantification and understanding technological aspects of building design.’ This reveals a possible ignorance towards BPS. Unappreciative attitudes are also likely to be built upon this ignorance; creating a two-fold problem. Architects are both unappreciative of the benefits and are increasingly conscious of limitations prohibiting BPS usage. This duality may collectively be discouraging architects' adoption of BPS as an integral element of the design processes.

Attitudes towards building regulations, standards and codes - Qualitative Insight 2.2:

Architects' poor perceptions of BPS benefits; coupled with surrounding legislative requirements, seems to render the belief that BPS is only a regulatory requirement; in architects' eyes. The majority of interviewees were unable to distinguish between BPS design tools and compliance tools; giving evidence to this perception. The direct link between compliance modelling and building regulations, standards and codes has made it imperative to question architects' attitudes towards the latter.

Predominantly unappreciative and ambivalent attitudes are traceable, such as, *“I’m 80% negative about Part L, but I’m sure every architect has the same opinion,”* and *“I’m not sure building regs [regulations] are as good as they are written.”*

Conclusive outcome: Ambivalence towards building regulations may contribute to forming negative attitudes towards BPS as a whole; particularly if architects solely acknowledge its function for compliance.

LEVEL 3: COLLABORATION WITH BPS SPECIALISTS:

Lack of appropriate knowledge, unappreciative attitudes and the view that BPS is only a regulatory requirement means that architects need to collaborate with BPS specialists to calculate performance. In most practices architects tend to collaborate with specialists; as shown in Figure 3.

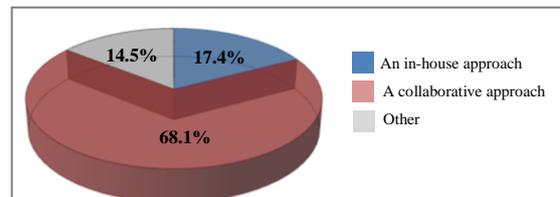


Figure 3: Pie-chart of BPS approaches used by architectural practices

The overriding opinion given by interviewees was that they should not do BPS calculations themselves, because architects *“are not qualified to do it. If we were to do it we would just get it wrong;”* Architects *“are not trained as building scientists,”* and believe BPS specialists should be brought in for this purpose.

Conclusive outcome: Another level of complexities is manifested when more professionals; usually from entirely different professional institutions, are added to the design team. The following insights underline these complexities.

The client as a barrier to early integration - Qualitative Insight 3.1:

The consensus generally is that BPS promises most benefit if implemented early; therefore BPS specialists should join the design team as early as possible. However, the interviewees argue that, *“it is rare that we get that opportunity to work with a simulationist...before we make a planning application;”* i.e. during Stage D of the RIBA Work Stages (RIBA, 2007). The questionnaire data supports this; as shown in Figure 4.

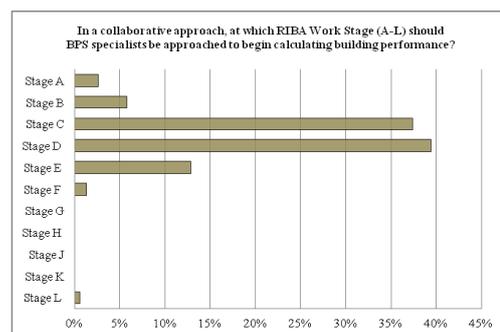


Figure 4: RIBA Work Stages at which BPS specialists are brought into the design team.

Interviewed architects argue that clients prevent early BPS integration. According to them, “*there’s no reason why it [early BPS integration] can’t be done other than the clients’ reluctance.*” In practical project settings, there is a social view of the client as the employer; at the top of the hierarchy. Architects are “*all appointed by clients*” and therefore, “*view those as your employer rather than your client.*” It is therefore essential that architects comply with clients’ business needs.

Moreover, much of the time clients tend to view building projects as “*a commercial exercise,*” and decisions are likely to be cost-driven. Every action is translated in terms of its financial implications. Collaboration at initial stages may be viewed as having to; “*to pay for two consultants right at the beginning, rather than the one that’s managing it.*” The questionnaire data complements this argument. As shown in Figure 5, 70.2% of respondents agree with the aforementioned quote.

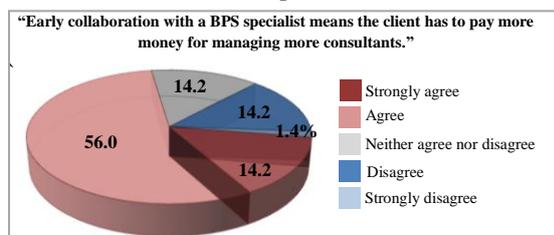


Figure 5: Pie-chart showing architects’ levels of agreement with the above statement.

Conclusive outcome: The social hierarchy of client and architect demands architects to conform to cliental requirements. If clients do not urge early integration; there is a lesser likelihood of it being enforced by the architect.

Trust in the collaborative effort- Qualitative Insight 3.2:

Lack of trust between multi-disciplinary collaborating practitioners also surfaced during as a likely socio-institutional hindrance to BPS integration. Particularly integrity and intuitive forms of trust were highlighted; from Hartman’s (1999) trust model.

Interviewee 2 questions his trust in professional integrity of BPS specialists he works with; “*I expect him [BPS specialist] to work with me. But there’s got to be a trust there. I’ve got to have an expectation that he will do his best.*” He also implies that intuitive trust is sometimes absent in collaborative project environments; “*if you come with a good attitude, generally it’s going to be fine. But if you come with a bad attitude, it’s the most horrible meetings in the world.*” Intuitive trust is

strongly linked to ‘stereotyping,’ mentioned earlier in this discussion. Since stereotypical formations are reliant on pre-formed judgements, they may reduce intuitive trust between professionals.

The question of trust is investigated further in the quantitative phase. As shown in figure 6, most respondents feel that there tends to be a trustful disposition between architects and BPS specialists. ‘Integrity, competence and intuitive’ forms of trust were not met with a comparable agreement.

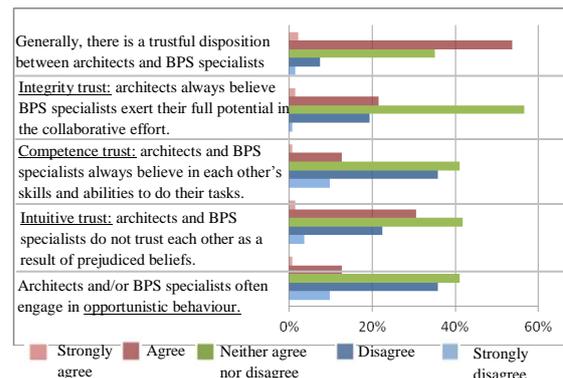


Figure 6: Trust in architect – BPS specialist relationships.

Conclusive outcome: The quantitative data has not confirmed the notion of distrustful relationships between architects and BPS specialists. Most respondents appear undecided. This emphasises the need to explore this phenomenon in more detail in future work.

CONCLUSIONS

An array of potential socio-cultural, attitudinal and behavioural hindrances are provoked in this article. In the authors’ opinions, it is equally important to address them alongside technical and software-level barriers. Human behaviour is characteristically illogical; manipulated by a profound variety of multi-layered complexities. It would be inaccurate to reduce thought-process to linear, mechanistic procedures. This is particularly applicable to architects; who are trained to challenge constraints in aspiration of creative solutions.

A rapid solution for integration is unlikely to have long-lasting impacts. The issues at stake here are embedded within architects’ thought-processes and years of practised traditions. The authors believe that a long-term solution may lie in changing the training system within the UK educational system to incorporate BPS as a fundamental design requirement; rather than the compliance add-on element it has become. In general, education is the basis on which architects base their entire belief-

system in the discipline. Current UK architectural education paradigms; following elitist philosophical traditions and purist aesthetical paradigms do not allow scope for numerical performance indicators to validate design-decisions. Unless architects are brought up to believe in the power and impact of BPS as an integral design element, it is unlikely to be merged within design activities, and will continue to be side-lined as an after-thought. Meanwhile, an area worthy of further discussion is whether ideologies resulting from UK architectural paradigms are particular to UK architects; or whether they are common amongst architects following different training systems in other parts of the world.

The status of integration; usually as a joint effort between architects and BPS specialists, provides only a temporary solution. On the surface, collaboration appears to be an enabling force. However, the interviews portray that collaborators view the situation as, “*you do your work and let us do ours;*” a comfortable isolation between members of averse epistemological traditions. Operating as disparate communities allows little overlap or acknowledgement of the others’ working requirement. Effective collaboration can only occur once a unified foundation is realised. Until then, collaboration may ironically be a disabling force.

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