A Multi-Level Model of Collaboration – Lessons Learnt from Social Scientific Interpretive Research

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Abstract

Many scholars claim that the impact of systemic innovation e.g. Building Information Modelling (BIM) is not as expected. Understanding the root causes, evaluating the implications and developing solutions should therefore constitute the main aspects of reflection. The literature contains numerous papers focusing on the adversarial and transient nature of the construction industry. However, authors feel that they fail to identify the root cause of the challenges. These affect the cohesion and the productivity of the industry with reflections on the efficiency and performance of construction projects. Holistic understanding is needed as changes need to reflect reality to bring positive results.

The research illuminated key elements, via a qualitative study which comprised of focus group discussions with multiple firms operating in design and construction in Norway, and one-to-one interviews with a project management firm in Finland. The focus groups and interviews were conducted around a central theme of collaboration in an unstructured manner to ensure meaningful data was collected which reflected reality. Thematic analysis was used to process the data, and the model was developed based on the most frequent themes. In addition, the experience of the authors from projects in multiple localities has been called upon to evaluate the results.

The purpose of this paper is to present a holistic model to increase understanding of the origin of challenges in collaboration at the project level in the AEC (Architectural-Engineering-Construction) industry. The aim of this model is to interpret the origins of the current reality of collaboration and its implications on future processes where more innovations may well be introduced.

Empirical findings suggest multiple origins of challenges systemically affect collaboration and digitalisation at the project level. The addition of Human Psychology and Culture (HP&C) as a foundation was used to reflect the natural characteristics of people emergent in the qualitative data. Overall, the findings provide evidence for systemic challenges related to interdependencies between the HP&C and project level, transactional, intra-organisational and industrial factors.

Keywords: Collaboration, Human Factor, Social Science, Psychology, Construction management

1. Introduction

Despite advanced technological development in the Architectural-Engineering-Construction (AEC) industry, exemplified by use of BIM, efficiency and productivity improvements have been negligible at a sector level, although with notable exceptions at a project level. This paper presents a multi-level model based on qualitative data centered on project level collaboration; the unstructured format brings multiple factors that interact reciprocatively. In this paper, the root of challenges and difficulties in the industry are argued to be heavily dependent on human constraints as a result of the decision-making process of people. Psychological theory regarding decision-making and cognitive/motivational biases has been applied to client-centered decisions to show the role of the rooted human nature (Sujan et al., 2019). These biases are said to be as a result of different types of beliefs (normative, behavioral or control) forming the foundation of decision making (Ajzen, 1985).

The study and its prequels (Sujan et al., 2019, 2018) go against domain trends; AEC literature is highly technical in nature (Hjelseth, 2017; Sousa & Mêda, 2012) and positivist in nature (Barrett, 2018), as such, awareness of hidden aspects are required for further understanding in practice and research. Sujan et al., (2018) presents the methodology used to study collaboration holistically and presents some empirical lessons. Further, Sujan et al., (2019) uses psychological theory and empirical data to show the dependency of client-involved decision-making on beliefs; the study formed the basis of using the multi-level model that is presented here. The paper thus aims to show the rooted nature of collaboration factors in human capability. Collaboration factors were extracted from qualitative data and put in a Holistic Model for Collaboration in the AEC industry (HMC-AEC) depending on its definition and interaction with other factors.

Therefore, the objectives of this paper are:
- To determine the importance of human factors
- To compare AEC models with similar industries' models
- To present a multi-level model that suits the interdependencies of factors with regards to collaborative working
- To assess current models used in the AEC industry and compare the HMC-AEC structure

2. Review of Literature

2.1 The Human Factor in Other Industries

The AEC industry is described as a Project Based Inter-Organisational Network (PBION) similar to the film, healthcare and defense industries (Taylor, 2005). Therefore, value can be driven regarding the human factor. The biopsychosocial approach was presented in by Engel in 1977, to show the reductionist's over-simplification effect in the biomedical model where physical origins are assumed to be causes of diseases. A patient's illness has been defined by western medicine in a reductionist approach from the 16th and 17th centuries with the idea that mind and body are separate phenomena, still a majority view in today's healthcare practice delegated by the biomedical model (Wade & Halligan, 2017). As Engel (1977) explained, with the biopsychosocial approach, there is a need to consider both the social/psychological and physical dimensions of illness and the patient. Although this simplification did have considerable success in the diagnosis and treatment of life-threatening diseases, well recognized illnesses with no physical origin are not accounted for (e.g., 'neurasthenia'). Other scholars supported this view that (Kleinman, Eisenberg, & Good, 2006) in simplifying the way knowledge is created, all possibilities of intervention or innovation are not captured (Kleinman et al., 2006).

The UK government released Human Factors Integration (HFI) regulation in the defense industry which seeks to provide a lens to the industry from a human capability standpoint and not discerning the more technical policies, made to supplement them (Ministry of Defence, 2015). The regulation

does not intend to give a technical and high level of detail; however, it provides a holistic view of the process by clarification of solutions which otherwise would have multiple methods. This is so that people can align their mental processes giving common ground for normative beliefs to develop as well as uniting the risk perception. Many risks at the project level are not independent nor systemic in nature; they have influence on multiple teams.

2.2 Integrated Design & Delivery Solutions (IDDS)

The IDDS model was developed as a grounded concept involving consultation with several hundred people around the world. Three parts of the model included collaborating people, integrated processes and interoperable technologies represented in a single level overlapping with IDDS in the center (Owen, Amor, Dickinson, Prins, & Kiviniemi, 2013). IDDS has had a significant impact in helping researchers and practitioners understand the complexity of the reality of collaborating using integrated processes and interoperable technologies. Additionally, its purpose is to develop new approaches to integrated design and to engender debate about the development of industry. IDDS' definition of collaborating people, was utilized as a point of departure.

3. Methodology

The Cynefin framework can be used to describe the value gained from an unstructured approach to qualitative data gathering (McLeod & Childs, 2013). The unstructured approach to qualitative data is utilized to gain an in-depth understanding of phenomena by understanding human experiences (Wildemuth, 2016, pp. 239–247). The authors wanted to understand the complexity of collaboration so that a model could help raise awareness of the hidden factors and interdependencies of factors. The aim was therefore to study complex phenomena and represent it in an ordered manner. From the Cynefin framework, complex aspects are investigated by a process of sense-making which involves exploration of concepts and dependency (McLeod & Childs, 2013). Similarly, in the development of the model, open approaches to data gathering gave the researcher a view of reality from the experiences and opinions of participants. Sense-making happened at two levels:

1. During the interview/focus group – the unstructured approach to qualitative data gathering requires the researcher to understand responses and respond dynamically with questions regarding further explanation or probes to bring out underlying aspects regarding phenomena discussed.
2. During the analysis – this involved being thorough with the data via thematic analysis and understanding the bigger picture by generalizing between types of participants and their opinions. Thematic maps of factor interactions were made to gain a holistic understanding of the complexity.

Table 1: Study Overview (Sujan et al., 2019)

		Study	
Location		**Study 1: Finland**	**Study 2: Norway**
Approach		End to End, One Firm Perspective	End to End perspective Multiple Firms
Duration		5 Days	5 Days
Method	**Focus Groups**	Nil	5 (14 participants)
	Individual Interviews	18	Nil
Analysis	**Qualitative**	Thematic Analysis	
Participant Classification		End to End Project Management (Design and Production Managers)	2 Contractors, 1 Project Management, 1 Public Client, 1 Consultant, 1 Industry Organisation

The aim was to use collaboration as a central theme to let the responses evolve based on reality. The main challenge with this approach was the intense and time-consuming analysis as different patterns

and structures of data arise from one session to another. This brings width and depth which enables rich data – the analytical approach lends itself to this data and is therefore not a limitation but a strength.

To add a further layer of analysis, semi-structured interviews were also conducted with experts from the UK AEC industry; the questions evolved as a result of analysis of Study 1 and 2 data and the developed model. The approach was to enable a level of validation to verify the analytical perspective of the researcher. The structure of the model was verified with all experts providing examples of the rooted nature of human psychology and culture in daily project practice.

4. A Multi-Level Representation of Inter-organisational Collaboration

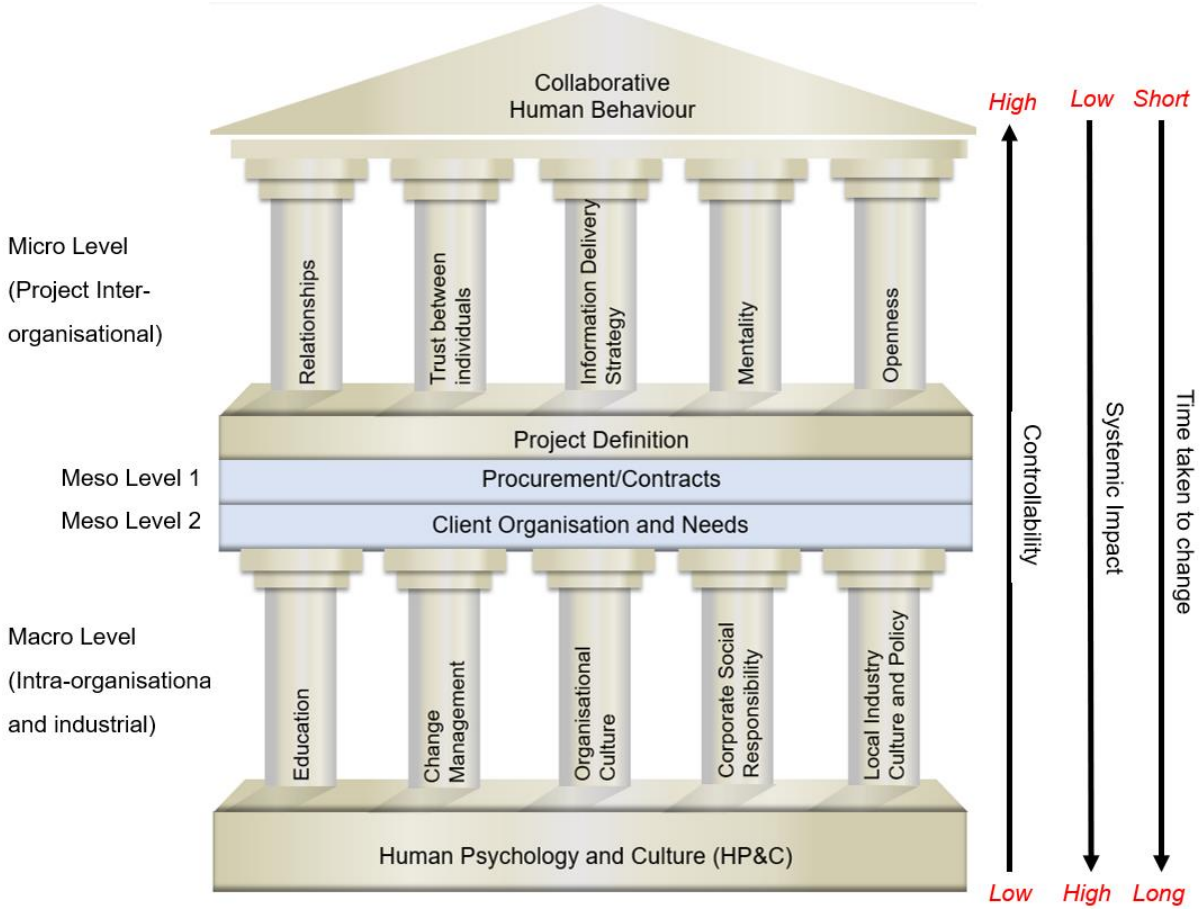

Figure 1: Overview of the Holistic Model for Collaboration in the AEC industry (HMC-AEC)

Figure 1 shows an overview of the levels of the Holistic Model for Collaboration in the AECOO-industry (HMC-AEC). The foundation for HMC-AEC is based on the Ph.D. thesis by Sujan (2019). The Micro, Meso and Macro levels are consistently defined as in Van Notten's external analysis model (Van Notten, Rotmans, Van Asselt, & Rothman, 2003). The Micro level represents the factors that are apparent at the inter-organisational project level. The Meso levels are respective of the transactional factors, which in this context are split between the client and the contracts. As represented in the figure, the client aspects are below the contractual aspects; empirical data showed that the contractual aspects depended on the nature of the client organisation. The way the contract is perceived or used in a project depends on client organisational culture and styles of dealing with project participants. The macro level represents factors found within organisations independently or at the industrial level which delegate normative practice. The novelty in structure is highlighted in the

level below the Macro called Human Psychology and Culture (HP&C). The factors found in this level are foundational to all the other levels and have a complex influence on each factor either directly or hierarchically. If an empirical factor emerged in all the other levels, it was repositioned in the HP&C level. For example, trust was initially at the Micro level, however, after expert interviews, it was found that it was present in all the levels and therefore was repositioned to the foundation.

4.1 Trust as an Example of Multi Level Interdependency

Figure 2 shows the categorisation of factors found from qualitative data and arranged in the Holistic Model for Collaboration in the AEC industry (HMC-AEC). The HP&C level should be perceived as foundational to all levels as it can be related to every other level in the model. This section uses trust to exemplify the nature of multi-level interactions between factors:

Micro – Meso 1: The link between individual trust and the Meso level can be viewed around financial incentives of a project; if there is friction between teams about win and loss this affects trust between them.

Meso 1 – HP&C: The way teams are selected is predominantly price based and transient in nature. Evidence suggests that trust development is not possible with all teams even if the social climate is positive. This means that there are characteristic traits of a team and individuals that require studying in the selection process.

Micro – Meso 2: The client is the main decision maker in the project. The relationship of teams with the client is found to be vital in having a positive social climate in the project; with a good relationship, people tend to exert more freedom to be open which means that there is more efficient communication between teams and the client.

Micro – Macro: Trust between organisations was related by experts to business ethical practice in the industry. From empirical evidence it was found that it is normal practice to provide information at tender stage (to win the project) that differs to reality after award.

Micro – HP&C: Trust between individuals was linked to the individual's attitude to trust/mistrust which is a result of multiple factors both from the individual and culture the individual works in. For example, personality is the individual aspect which directly affects the way the said individual trusts, a trustful personality will begin relationships at the point of trust. External aspects include cultural expectations of behaviour and process which became evident when participants described interactions with firms that were not from the local industry. These expectations are developed from years of normative practice and socio-cultural aspects relating to business practice.

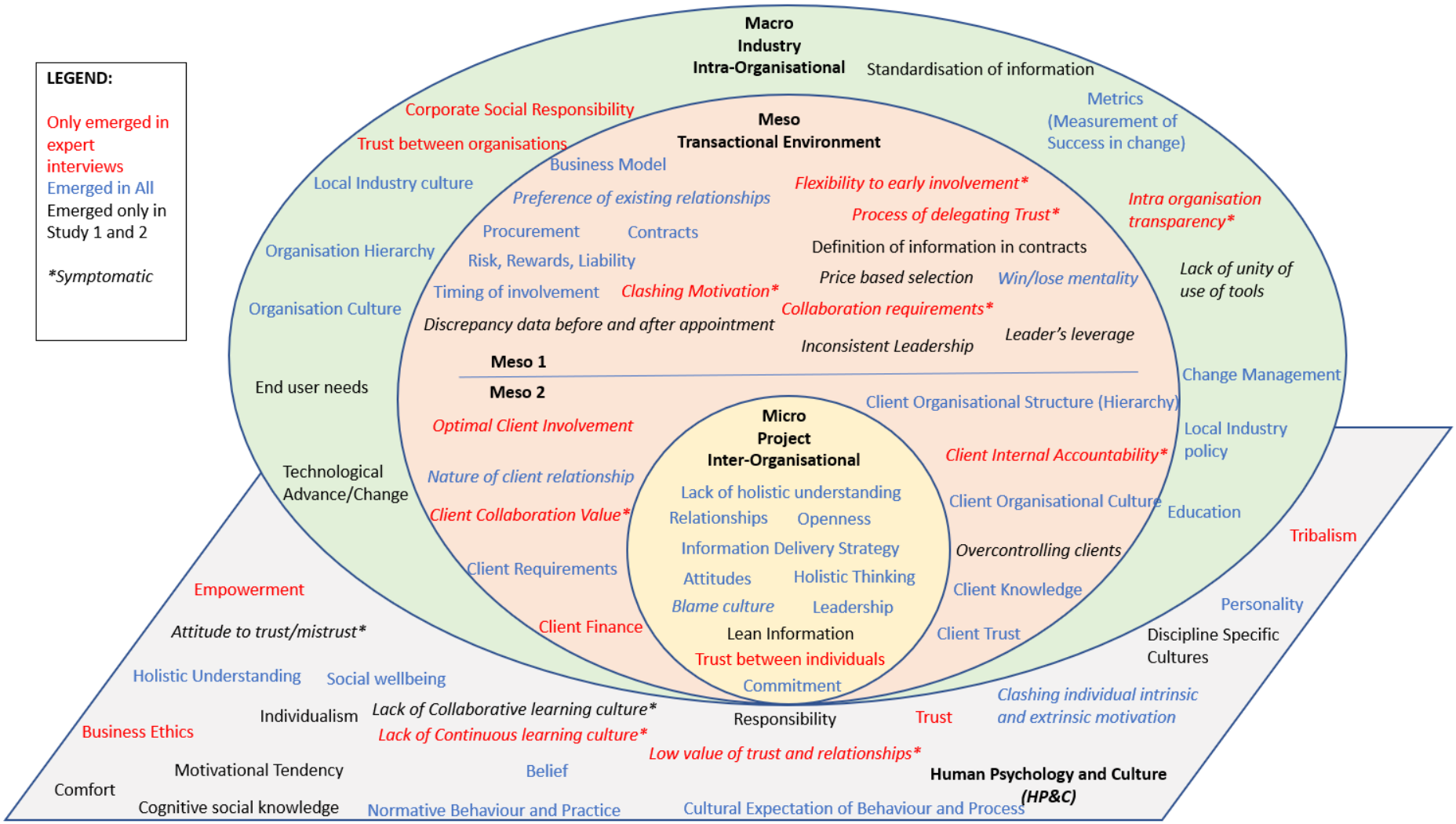

Figure 2: Categorisation of Factors from Empirical Evidence in Micro, Meso and Macro levels in the HMC-AEC-model

4.2 Motivation, Contracts and Social Climate

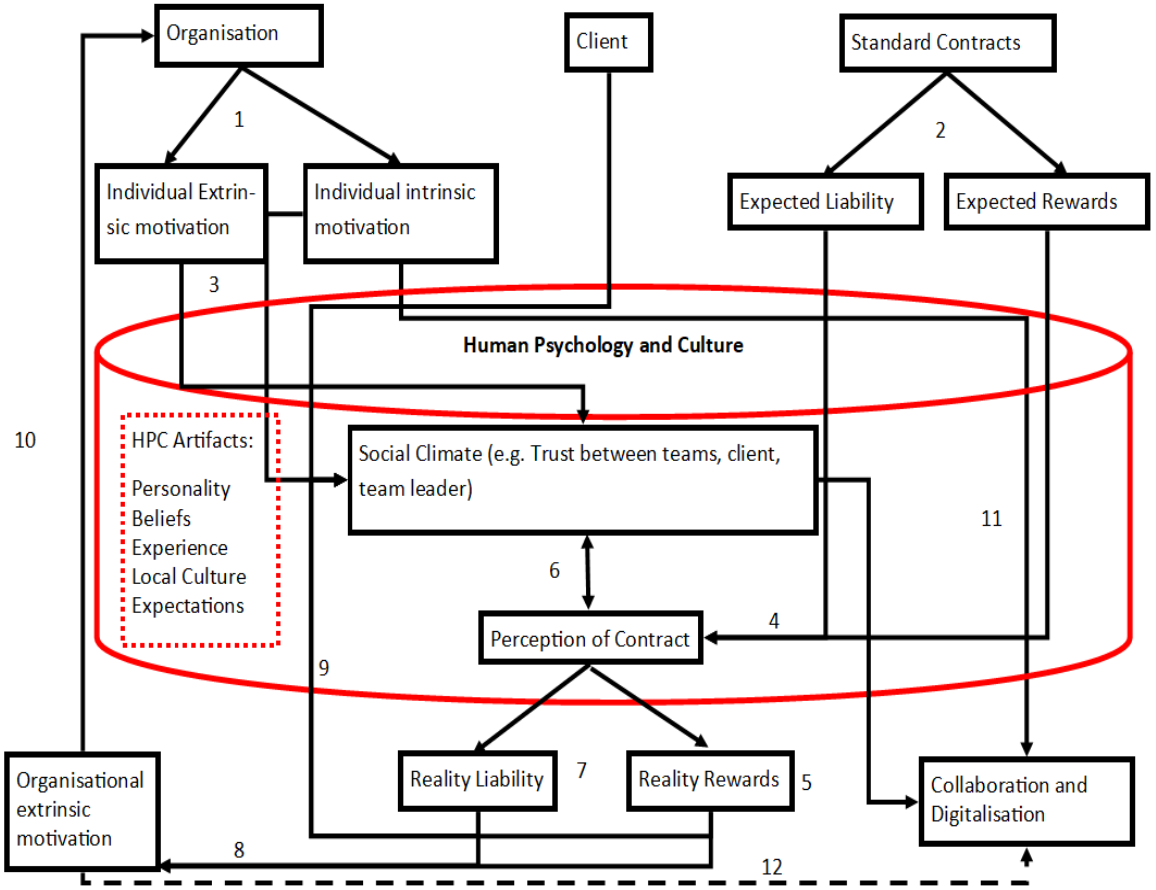

Figure 3: The Role of HP&C in Contracts and Motivation of Individuals and Organisations

Figure 3 shows the way the contract is perceived and motivates organisations and individuals which depends on the social climate and organisational factors. There is a difference between the expected liability and reward (2) and the realistic liability and reward (7) as contractual features are subjective (Bresnen & Marshall, 2000). These subjective elements are, for example, the definition of extra work. Due to the subjectivity, there is a dependence on the social climate of the project (6) which highlights the complexity of the HP&C level as it depends on people's perceptions. Rose and Manley (2011) conducted case study comparisons and found that the social climate is more important than the financial incentives set by contracts in motivating individuals, demonstrating the importance of the HP&C level of the model.

Since project level participants are hired by the firms and not the projects, this brings a higher order of complexity in studying motivation. The extrinsic organisation motivation from the project to the firm is translated to individual motivation dependent on the way that the organisation motivates its employees and varies between organisations (10, 1); this increases complexity, as it related organisational factors to the way a firm motivates its task force. In the grand scheme of collaboration and digitalisation, it is argued that innovative action is motivated intrinsically (11), see Barrett (2018). Extrinsic motivation is performance and profit oriented where typical firms put pressure on individuals to ensure their organisation is profitable from a single project. This is inconsistent with the needs of innovation activities which require more time and learning bringing a profit vs. professionalism dilemma in the behaviour of project level participants (Barrett, 2018); the individual extrinsic and intrinsic motivations are clashing dependent on organisational mechanisms to motivate individuals.

4.3 Comparison of Human Factor in AEC and Other Industries

The defense industry, unlike the AEC industry, has regulated processes with respect to human factors. The need for the AEC to have regulation of human factors was expressed by experts interviewed. Indeed, one expert explains the absurdity in 'a multimillion-pound project failing because of personality clashes'. An expert with experience in the defense industry explained there is need to consider human capability and mitigate risks from interactions between human capability and project processes. Regulation streamlines the process practitioners take to consider human capability, which brings greater unity in project risk perception. The abstract overview used by the HFI regulation is similar to the IDDS model (see Figure 4) but adds a foundational level referred to as the 'environment', which is dependent on human capability. In the IDDS model, human capability is captured within the 'collaborating people' part of the model. It is suggested that the human psychology and culture part of capability (environment) is also found to affect all parts of the model and therefore requires foundational setting as in the HFI regulation. However, human capability as in the HFI regulation goes beyond human psychology and culture, making the contribution of this paper visually represented in the abstract model below:

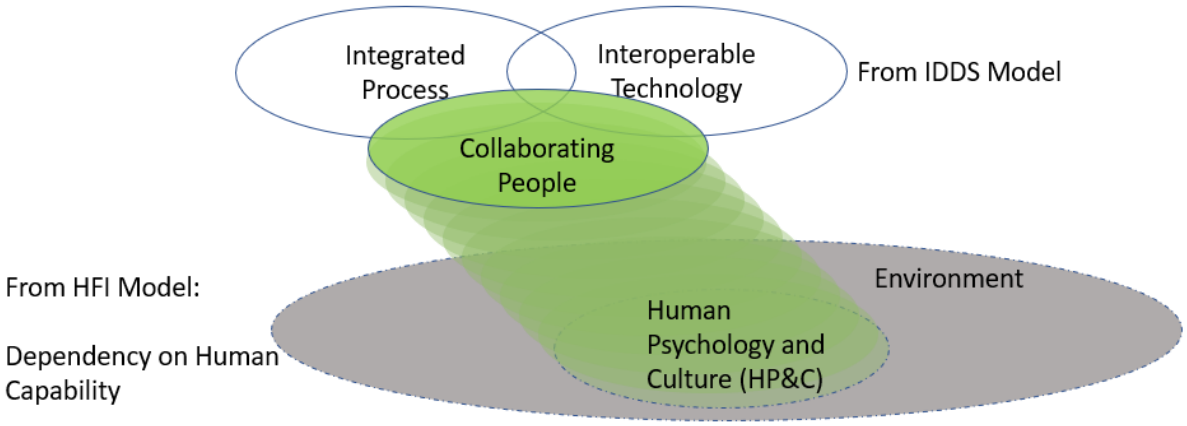

Figure 4: Contribution from Defence HFI to AEC IDDS perspective (adapted from Ministry of Defence, 2015; Owen et al., 2009)

The interpretive research presented both in this paper and in other literature, explain the need to consider the social and psychological dimensions in solution delivery (Barrett, 2018). Collaboration in healthcare requires the patient and the healthcare team to share a common understanding of the illness (i.e., to use the same model) or management may fail (Horowitz, Rein & Leventhal, 2004). Central to this exchange is trust (Zhixia & Mengchu, 2018). Similarly, in the AEC industry the client requires to have a similar thinking process to teams enabled by an open collaborative environment. However, as empirical evidence suggests, beliefs driven from experience and culture create a barrier between client and teams bringing about mistrust.

From healthcare, it is evident that the historically driven reductionist approach forms the norm in education and research and therefore in daily practice, however, interventions to encourage holistic thinking are in healthcare education based on the biopsychosocial approach. In the AEC industry and this research, education emerged in both Studies 1 and 2, and all experts explain the siloed nature of discipline specific education having an impact in inter-disciplinary solution delivery. This is reproduced from project to project in the design stage, leading to challenges identified in literature (Mêda, 2014); this was related to industry fragmentation and use of traditional contracts. The cause of this siloed nature is disputable; however, engineering courses are highly reductionist/positivist whereas architecture courses tend to be more interpretive according to experts. Furthermore, many educational institutions take on fragmented discipline specific education delivery. Therefore, knowledge transfer to practitioners from education is siloed; an expert explains that intern training at their firm is predominantly in negotiation and people skills to bridge the gap of human factor understanding and skills.

Although many scholars raised awareness and received credit in the healthcare sector about biopsychosocial model addressing missing parts of the biomedical model; a paradigm change has not yet occurred (Wade & Halligan, 2017). Similarly, in the AEC industry, firms are operating in a fragmented industry motivated to reduce risk. However, digitalization is suited by higher integrated environments bringing about a paradox in the industry both in behaviour of people and in business model innovation. The model presented in this paper can be utilized to raise awareness of the value of HP&C aspects both in research and practice. One expert explained the impact of the model as a pedagogic tool, to get students and practitioners to understand the bigger picture of their operations. Furthermore, as an outcome, AEC education could take on case study reflections, such as those performed in healthcare, to allow students to venture outside the discipline specific boundaries to raise awareness of otherwise hidden aspects.

The impact of the transactional Meso level is worth highlighting. For example, for a design team in traditional processes, the contractual outcome is the technical design rather than the built object. This restricts teams' capability to get involved in the built objects' development. Focusing on the built object would constitute a paradigm shift implying changes in designer culture. To the client/owner, it implies a new business culture, requires commitment and management knowledge. Schedules, motivation, work processes and stress can vary substantially depending of the client/owner's commitment to the project.

5. Closing Remarks

An interpretive, social scientific research project was used to understand the reality of collaborating teams. The reality-driven data was enabled by an unstructured format of interviews and focus groups with a central theme of collaboration. The external analysis model used predominantly in organisational science was found to best suit the nature of interactions between themes. The foundation for the Holistic Model for Collaboration in the AEC-industry (HMC-AEC) was introduced as a result of observed Micro, Meso and Macro dependency. These factors are human oriented and therefore categorized under Human Psychology and Culture (HP&C). The rooted nature of HP&C factors is as a result of limitations inflicted by human capabilities and means these factors need to be considered carefully when setting up and running a project. Furthermore, the HMC-AEC can raise awareness of the need to consider the nature of humans to practitioners and in future research; identifying the way that the Meso level can be set (e.g. contractual forms, client relationship management). In comparison to existing models of collaboration, the model is one of the first in the domain to place significance of people at the foundation. The high complexity of the origins of expectations and other human psychological and cultural aspects discussed here drive individuals to use belief-based heuristics as a default to make decisions. Therefore, to create enterprise in the industry, changes in beliefs need to accompany changes to process and technology. Ultimately, individuals need to know what to expect as any changes are not only organisational but also personal.

This study illustrates that the industry can learn new ways of understating collaboration (or HP&C) from other industries and unstructured approaches to data collection. There is a challenge to deal with the complexity in collaboration in a systematic professional manner. This study has demonstrated practical use of the HMC-AEC model to improve understanding of factors and their dependencies related to human capability by exemplifying dependencies between the human oriented factors (HP&C) and Micro, Meso and Macro levels. This reduction of complexity makes it possible to identify most relevant factors in a systematic and reality driven manner. The HMC-AEC model enables a foundation for professionals and educators in the AEC industry to turn otherwise complex multi-level phenomena regarding HP&C into manageable understanding and systematic improvements. The model also provides researchers with a holistic vision of the complexity of collaboration in practice; by considering multi-level factor dependencies exemplified here, methodological design can be envisioned and improved. Further research is required to extend this model from AEC to include owners and facilities management to cover the whole building lifecycle,

to facilitate consistent and improved holistic perspective.

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