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# A Socio-Cultural Perspective to BIM Adoption: A Case Study in South Africa

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**Abstract.** The implementation of BIM in construction organisations requires various strategic and change management processes. The effect of organisational culture, manifested through external survival issues, internal integration issues and underlying assumptions, on BIM adoption are absent in the literature. This paper aims to illustrate that a focus on these three level of cultural manifestation within AEC organisations could lead to improved analysis of BIM adoption. An architectural organisation based in South Africa is used as a case study. Mixed method of data collection was adopted to analyse BIM's manifestation in an Architectural organisation's culture. Interviews were conducted with key members in the organisation, and survey data of 29 respondents was used to triangulate and develop consensus about the underlaying assumptions relating to BIM. The results showed how each of the three levels of cultural manifestation is influencing BIM adoption. In particular, the findings revealed that leaders' perceptions greatly impact the adoption of BIM through the three levels of the organisational culture.

**Keywords:** Building Information modeling, BIM, BIM diffusion, cultural values, behaviour, organisational culture.

## 1 Introduction

The construction industry has remained innovatively static [1] despite decades of exposure to its waste and inefficiencies [2,3]. The industry's fragmented nature is still challenged by the lack of collaborative project delivery systems and the limited adoption of interoperability standards, and the scarce automation of project processes. Building Information Modelling (BIM) is proclaimed as the industry's panacea and is alleviating some of interdisciplinary inefficiencies within the construction industry. BIM is the current expression of digital innovation within the construction sector [5]. BIM adoption contributes: 1) reduced project lifecycle costs; 2) increased productivity, efficiency, infrastructure value, quality and sustainability; 3) effective communication and collaboration amongst project stakeholders [4]. Although governments and institutions around the world have started to strategize and mandate the use of BIM in construction projects [5]. This is not the case in other parts of the global construction market. For example, in South Africa the demand for BIM in both the public and private

sector is still very scarce. South African architectural organisations have very little guidance and skills to successfully adopt BIM processes and workflows. At this embryonic phase of BIM adoption within South Africa, it is important to investigate the socio-cultural effects of BIM adoption. According to [6], the culture of an organisation is considered as a driving factor of BIM adoption. In addition, various authors have called for a culture change in the industry to enhance the BIM diffusion and to meet sustainability targets [7-10]. This paper investigates the inherent effect of BIM on organisational culture with the focus on the South African construction industry. The work is based on Schein's theories of organisational culture, with the implication that strategic focus on certain aspects of BIM might aid organisational cultures to adapt to the external environment.

## 2 Building Information Modelling (BIM)

Since its inception in 2002, authors have initially described BIM as a technology or "tool" [11-13], referring mainly to the software used on AEC projects. However, [14] pragmatic definition of BIM as "*a set of technologies, processes and policies enabling multiple stakeholders to collaboratively design, construct and operate a facility in virtual space*" has acknowledged the increasing connotation of BIM. The most prevalent use of BIM relates to early design usage such as visualisation, 3D coordination, design authoring and analysis, whereas lifecycle uses such as maintenance scheduling and building system analysis are still limited [1, 15].

South Africa has yet to develop BIM mandates on an institutional level [16, 17]. BIM adoption in South Africa has received very little traction in both the public and private sectors, thus lagging behind developed countries [16]. South Africa widely accepts the UK's BIM maturity model as a standard approach to measuring the competence of BIM adoption [18]. However, the UK's and ISO 19650 standards, are mere guidelines in South Africa, and is only partially followed due to differing construction processes and culture [19].

In a study on BIM diffusion, [20] found that the main influence behind BIM adoption can be attributed to how the construction industry places value on internal factors and imitation behaviour, rather than external factors. The external factors in a diffusion model refer to regulatory and empirical evidence by governments and institutions of the potential benefits of an innovation, whilst imitative behaviour can be explained by the bandwagon effect in innovation diffusion. Consequently, the effect of BIM diffusion depends on the strength of the industry adopter's network [21]. Industry networks describe clusters of organisations that have developed recurring ties through projects, shared information and work closer together than other organisations within the industry [22]. Due to the construction industry's notorious conservative and fragmented nature [23] [17] and with very little previous inclusion of facilities management in construction processes, Kent's network theory reveals why survey findings show little BIM uptake in the full lifecycle of construction projects [21]. Cao et al. (2014) argue that the client/owner exerts social pressures on AEC professionals on a project level, leading to conformity pressures [24]. This therefore supports the

bandwagon theory because despite the ambiguity about the profitability of BIM innovation, adopters are under social pressures to adopt BIM to avoid losing legitimacy in the industry [20]. BIM implementation within AEC organisations wields the same imitation behaviour as on projects. Without detailed knowledge of BIM or its impact on organisational practices, organisations implement BIM technologies, acquire training, appoint BIM managers, and process documentation based on social cues to ensure legitimacy in the industry [24]. Various authors have found that the dissemination of BIM technology on traditional practices in organisations has led to adoption barriers [25] such as resistance to change, unestablished contractual foundations, fragmentation and inertia, poor people management strategies, lack of buy-in from organisational and project stakeholders, unfavourable trust and risk behaviours, and misperceptions on BIM [26] [23] [4,5]. On an employee level, BIM adoption renders some deep-rooted workflows and behaviour dysfunctional, which violates identity and causes anxiety between individuals to lose group membership. Consequently, change causes an unlearning of sorts, which causes resistance to change [27] or BIM wash. Therefore, [21] points out that an organisation's culture should be changed to create an environment for innovation learning rather than protecting old practices. Based on architectural organisations' position in the early design network, architects are in a predominant position to influence the speed and depth to which innovation is diffused through the industry. Once motives for behaviour are understood, organisations will be able to change towards adaption or even advance toward a competitive market.

## 3 Organisational BIM Culture

Numerous definitions of organisational culture exist; however, the most common lay term is "the way we do things around here" [28]. Organisational culture is manifested in the right way things are done, or how problems in the organisation are understood and resolved.

A culture is formed through the personal goals, beliefs, values and assumptions that the founder believes "how things should be". The founder's views are imposed on the peers and, as the founder's views and behaviour result in success, the behaviour is recognised as the "right way" and shared to new members of the group [27]. The view that top management are the architects of culture is common in academia [6] [29, 30]. An organisation's culture is often viewed as unitary and unique, characterised by a stable set of meanings [29]. However, this view can be challenged in two ways: 1) organisational culture is ultimately affected by its host culture; 2) each organisation comprises of various sub-cultures as members often group themselves in smaller societies relative to their needs.

Host cultures are the normative external cultures that the organisation establishes itself in (such as national cultures, industry culture and educational cultures) and forms the basis of initial assumptions which assist members to relate to one another. It is here that the impact of environmental changes, including technological advancements such as BIM, plays a big role in cultural changes in industries. On the other hand, internal

cultures or sub-cultures are formed within an organisation where group members are often organised based on their location, designations, disciplines or projects. The level and circumstances of cohesion between the sub-cultures can define the strength and health of the organisation and its ability to change [29].

When political, societal, and technological environments change, people's cultural values also change [31]. An organisation's ability to change and adapt to its environment is critical for survival in a competitive market. In order to understand the contributory and complementary role of external influences and the organisation's internal environment, this study adopts the Schein (2006) approach, according to which "a pattern of shared basic assumptions that a group learns as it solves its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think and feel in relation to those problems" [27]. Hence according to [27], the problem with deciphering culture in an organisation is to surface the group assumptions. Figure 1 presents three levels as defined by Schein, at which a culture can be analysed by; artefacts & creations, values, and basic assumptions.

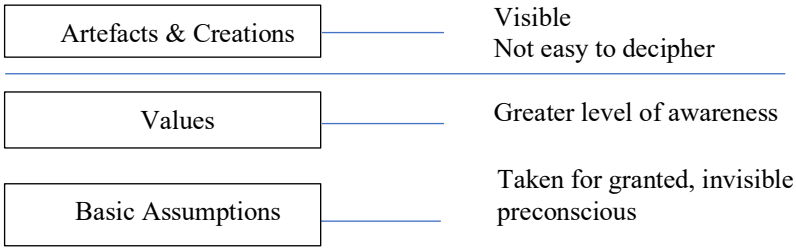


**Fig. 1.** Schein's (2009) Three levels of Culture. p21. [32]

**Artefacts:** Artefacts are the visible elements of an organisation such as documents, the physical layout of the office, technology and visible audible behaviour patterns etc. Artefacts are easily seen by an outside observer, but the cultural aspects thereof are hard to decipher.

**Values:** Values govern behaviour, which is the next level of culture. It refers to the communal focus on what people say is the reason for their behaviour. Though, values do not uncover the underlying reasons for organisational members' behaviour.

**Basic Assumptions:** These taken-for-granted assumptions which are unconscious to the group and are the reasons why members perceive and think a certain way. Basic assumptions are learned responses that originated as organisational values.

In analysing a culture, [27] suggests a structured qualitative approach in the following three areas of an organisation to uncover the three levels of the culture:

- **External survival issues** which can be analysed in the organisation:
  - Mission, strategy, goals.
  - Means: structure, systems, processes.
  - Measurement: error-detection and correction systems.
- **Internal integration issues** found in:
  - Common language and concepts.
  - Group boundaries and identity.

- The nature of authority and relationships.
- Allocation of rewards and status.

➢ **Deeper underlying assumptions** in:

- Human relationships to nature.
- The nature of reality and truth.
- The nature of human nature.
- The nature of human relationships.
- The nature of time and space.
- The unknowable and uncontrollable.

Schein's (2006) model for analysing an organisational culture is widely accepted [27]. Therefore, to form a framework for cultural analysis, Schein's three-level model is merged with the three levels of cultural manifestations to ensure the study uncovers the underlying assumptions surrounding BIM adoption as displayed in Table 1.

**Table 1.** BIM's Cultural Values Research Model.

| **Analysis Focus** | | Artefacts | Values | Basic Assumption |
|---|---|---|---|---|
| External Survival Issues | Mission, strategy, goals | x | x | |
| | Means: structure, systems, processes | x | x | x |
| | Measurement: error detection, correction systems | x | x | |
| Internal Integration Issues | Group boundaries and identity | | x | x |
| | Nature of authority and relationships | | x | x |
| | Allocation of rewards and status | x | x | x |
| Deeper Underlying Assumptions | Human relationships to nature | | | x |
| | - Organisations' relationships to its environment | | | x |
| | - Nature of Human Nature and Activity Internally | | | x |
| | The nature of reality and truth | | | x |
| | - Nature of space and time | | | x |
| | The nature of human relationships | | | x |
| | The unknowable and uncontrollable | x | x | x |

This merge reveals the areas of focus and influences to uncover the cultural values relative to BIM. Therefore, by adding a BIM overlay, the degrees of BIM abstraction within the organisational culture can be realised.

According to the above analysis, the reality of BIM manifestation within the organisation's culture can be achieved by the consensus of values between all members throughout the organisation and hence, this study aims to understand this phenomenon.

Once the reality of BIM in an organisation is revealed, recommendations can be made to further promote BIM adoption for competitive advantage in the industry and ultimately influence the wider industry network's BIM diffusion rate.

# 4 Methodological Steps

In order to answer to the research questions derived from the literature, this study will use mixed method approach to collect data in three phases in correlation with Schein's three levels of culture, as displayed in Table 2.

**Table 2.** BIM's Cultural Values Research Model.

| Phase | Cultural Level Analysis | Data Collection Methodology |
|---|---|---|
| Phase 1 | Artefacts | Observation, survey |
| Phase 2 | Values, assumptions | Interviews |
| Phase 3 | Basic assumption validation | Survey |

The data collection phases, as guided by the Schein's methodology were addressed by using the following strategies:

a. **Interviews:** to achieve consensus among key members of the organisation in order to uncover the espoused values and basic assumptions by targeting the participants situated in key offices as mentioned in Table 3.

**Table 3.** Interview Participant Details.

| Participant | Role in AO1 | Discipline Background |
|---|---|---|
| Owner | Managing director | Architect, 22 years' experience |
| Leader | Executive director | Architect, over 20 years' experience |
| BIM Manager 1 | Associate BIM manager | Architectural technologist, 9 years' BIM experience |
| BIM Manager 2 | BIM manager | Architectural technologist, 7 years' BIM experience |

b. **Survey:** to gather a greater audience for consensus and to validate discussions of the interview by targeting randomly sampled 29 employees, among which 13 has previous experience in BIM.

The findings from the interviews and survey aids in measuring BIM's manifestation in an organisational culture, which is presented in the next section.

# 5 Results & Analysis

The aim of this section is to analyze BIM's manifestations within the organisation's external survival issues, internal integration issues, and underlying assumptions. Only once a consensus among the key members of the organisation is reached [27], the

manifestation of BIM in the culture can be revealed. Therefore, findings of the interviews with key members of the organisation, triangulated with the aid of survey data are summarized and compare in the following sub-sections:

### 5.1 External Survival Issues

The primary determinant of behaviour in an organisation i.e. AO1 is the company's efficiency values encompassing its mission, goals, performance, and correction. Therefore, this section aims to present the summarised findings; achieved by interviews and triangulated by survey data in comparison to Schein's definition of external adaption issues as displayed in Table 4 [27].

**Table 4.** BIM Culture's External Adaption Functions.

| Schein's (2006) definitions | Summary of Findings |
|---|---|
| **Strategy:** | |
| Developing consensus on the primary task, core mission, or manifest latent functions of the group. | Key to the organisation's mission is efficiency. Consensus reached that 'BIM is a tool' to increase efficiency. |
| **Goals:** | |
| Developing consensus on goals, such goals being the concrete reflection of the core mission. | The consensus on long-term goals are reached, however, not in short-term goals. |
| **Means for Accomplishing Goals:** | |
| Developing consensus on the means to be used in accomplishing the goals – for example, division of labour, organisational structure etc. | Consensus reached on creation of BIM teams and roles, not on the wider transformation of the organisation's structure |
| **Measuring Performance:** | |
| Develop consensus on the criteria to be used in measuring how well the group is doing against its goals and targets, i.e. information and control systems. | Consensus reached on the need to develop external and internal BIM performance measurement systems. |
| **Correction:** | |
| Developing consensus on remedial or repair strategies as needed when the group is not accomplishing its goals. | Problems are corrected though BIM assistance and BIM training. |

The investigation revealed that there exists no concrete strategy document to articulate the mission, and staff members are referred to the AO1 practice manual to understand how "things work around here". However, BIM does not feature in this manual as the manual's development preceded BIM adoption. The findings reveal a widespread agreement among members of the group that the perception of 'BIM as a tool' can support the strategy and increase productivity goals in the organisation. However, due to the incipient and scattered nature of BIM implementation within the organisation, top management are not fully aware of BIM impact on efficiency and, in turn, there are unsure how to measure and where to benchmark their organisation performance. The BIM Managers did, however, identify their internal barrier for

growth as “a lack of buy-in from top management”. Their external barriers are similar to international adoption barriers discussed in the surveys [1]: “the consultants don’t use BIM”, “lack of client demand”. However, the Owner later revealed that AO1 can influence their clients to appoint consultants that use BIM software. The lack of buy-in can be directly tied to the perception that BIM is just a tool, and changes in operations due to this “tool” will yield investment and loss of productivity, which ultimately goes against the organisation’s mission of being efficient. Further, the consensus among the group suggests that the structure, error detection, measurement and correction systems were all built around the efficiency values of top management. BIM has been identified as the means to achieve efficiency. And despite the limited buy-in caused by its perceived adverse effect on productivity during implementation, the organisation’s structure I is changing to accommodate BIM roles which is an indication of the influence and power that efficiency values have on this organisation.

## 5.2 Internal Integration Issues

For a group to accomplish tasks that allow them to adapt to their environment, they must develop and maintain internal relationships [27]. Therefore, for the adoption of BIM in an organisation ’s culture, internal integration is a significant concept which is the focus of this subsection is important. The summarised findings from the data collection phases in comparison to Schein’s internal integration problems are displayed in Table 5.

**Table 5.** Internal Integration Factors.

| Schein (2006) | Summary of the Findings |
|---|---|
| **Boundaries** | |
| Consensus on group boundaries and criteria for inclusion and exclusion. One of the most important areas of culture is the shared consensus on who is in and who is out and by what criteria one determines membership. | Consensus was reached that BIM experience and BIM knowledge gives membership in the group, whereas a reluctance to adapt – despite correction measures - will exclude members. |
| **Power and Status** | |
| Consensus on criteria for the allocation of power and status – on how one gets, maintains and loses power. | Consensus that staff members have full autonomy in processes until there are problems |
| **Intimacy** | |
| Consensus for the criteria for intimacy, friendship and love. The rules for peer relationships and the way openness are handled in the context of managing organisational tasks. | Consensus on openness which reveals trust and risk taking as espoused values, however with inconsistencies. |
| **Rewards and Punishments** | |
| Consensus for the allocation of rewards and punishments. Every group must know | No consensus was reached on the rewards of BIM. |

| | |
|---|---|
| | what gets rewarded with property, status and power. |

From AO1 perspective, the summarised findings of internal integration illustrate that to be acknowledged in the group, one needs BIM knowledge and a willingness to conform to efficiency requirements. The BIM managers serve as a safety net if staff would like to engage in experimentation, and as a buffer between staff and management when there are problems. Except for efficiency, articulated espoused values in AO1 include openness, trust, and risk taking. Further, inconsistencies between what is said and what is observed are revealed in both the espoused values and reward systems.

It appears that even though BIM processes have creeped into both the organisations external survival problems and internal integration issues, BIM's manifestation are more visible in the external survival areas than in the internal integration. This might be due to the external social cues on BIM adoption, as discussed in the literature (Cao et al., 2014), while the internal integration is left to discover adoption for itself. Therefore, the internal integration relies on the deeper assumptions of BIM to inform the processes of BIM manifestation.

### 5.3 Deeper Underlying Assumption

The assumptions developed during external adaption and internal integration reflect deeper assumptions about more abstract general issues, around which people need consensus [27]. Schein's internal integration problems in comparison to the perspective of AO1 is displayed in Table 6.

**Table 6.** Underlying Assumptions Schein (2006) [27].

| Schein's (2006) definitions | Summary of the Findings |
|---|---|
| Organisation's relationship to its environment | We are technologically advance in a South African architectural context |
| Nature of reality and truth. | BIM is a tool for efficiency |
| Nature of time and space. | Authoritarian style focused on openness |
| Nature of human nature, activity, and relationships. | We will give you the platform, take the lead and succeed |

From the analysis the assumption is drawn that even though AO1 strives to be the leaders in their industry, they are trapped in isolation BIM processes which hinder the achievement of their goal. However, the organisation pragmatically adjusts to their situation and has done so with BIM adoption. This organisation has a "doing" culture mainly focused on efficiency; however, their staff are key to that efficiency. Staff should develop their skills with the help of the BIM managers to be efficient. The Owner and Leaders' assumptions around BIM in AO1 includes:

- BIM is a practical tool to increase efficiency.
- BIM changes how AO1 operate but it does not define them.
- Higher BIM skills makes one more valuable in a project team.
- AO1 perceives to be ahead of their competition.
- Staff must take initiative to grow.
- The BIM managers function as the safety net when things go wrong.
- The dynamics in the team affect efficiency.
- In there was a strong feeling that BIM is secondary to architecture, instead of being part of the architectural process.

Based on the agreed assumptions derived from the analysis, the BIM culture in AO1 could be summarised in the following points:

- The BIM culture is relatively new and not fully implemented in the entire company.
- The BIM culture drives efficiencies and profits in the organisation.
- The present BIM culture perceives itself as strong enough to endure any future changes in technology or BIM processes.
- The key strengths of the BIM culture are:
  - ✓ High degree of learning and skills development catered to all levels of staff.
  - ✓ The staff have full autonomy to experiment and to enhance their capabilities.
  - ✓ BIM managers buffer between the technical core and top management.
  - ✓ High degree of practical standards to achieve efficiency.
  - ✓ Status is gained from BIM knowledge and experience.
  - ✓ BIM forces collaboration and therefore colleagues trust each other.

# 6 Discussion & Conclusion

This research indicates that the Owner's perception that BIM is just a tool has greatly affected the scale of BIM adoption in the organisation. This organisation operates in line with its host culture which is currently siloed and fragmented, even though they have the power to break down the siloes through fully adopting BIM and its collaborative processes. However, this responsibility comes with great uncertainty which threatens the core mission of this organisation: its efficiency.

Aspects of BIM have been found in every cultural aspect within this organisation. However internal barriers are hindering the expansion of BIM abilities. The research uncovered that, due to the current organizations being profitable coupled with a significant focus on productivity, top management is unaware that current practices are inefficient. As a result, the BIM managers are faced with a lack of buy-in when it comes to changing processes. The predisposition that BIM is a tool separates BIM from architectural practices, also creates a barrier for BIM managers to adjust operational and cultural aspects such as:

- Changing the way staff are hired to grow technological diversity.
- Change operational documentation to inform new staff on how things are done.

- Enforce BIM practices through client's consultation and consultant collaboration on projects.
- Educate top management on BIM processes to enable them to drive the BIM strategy to achieve the organisational vision.

To address these concerns, BIM managers should develop a BIM strategy, clearly defining the goals for BIM and the processes to achieve those goals. The strategy should be created in conjunction with top management and other members of the organisation to ensure they buy into the strategy. Not only will management's assumptions be revealed and addressed, but staff will feel empowered to take the lead in achieving BIM goals.

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