Virtual materiality provided by BIM models in design collaboration

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In the presentation I analyze tangibility provided by BIM models in designers' collaboration. It is based on an unpublished article (Paavola & Miettinen, in press) where we called this kind of tangibility, or concreteness, "virtual materiality". It can be maintained, however, that "virtual materiality" is almost like a contradiction in terms. One of the reviewers of our paper said that if the models are virtual how can they provide "concreteness"? Can a "virtual" model afford tangibility? Virtual is often defined as "not physically existing" and tangible "perceptible by touch". In this presentation I aim at showing why "virtual materiality" is an apt characterization for the uses of BIM models in designers' collaboration.

In the literature on design collaboration and engineering work some classic papers highlight the role of visual representations (like sketches, or design plans) as means of communication and collaboration in face-to-face meetings (Henderson 1999; Schmidt & Wagner 2004). Visual representations "allow intangible ideas to become concrete – but still allow ideas to be reworked and renegotiated" (Henderson 1999, 200). Henderson calls this "work on paper" (see also Olson 2009). Designers' meetings consist of indexical interaction around artefacts, like gesturing, navigating, annotating, viewing (Tory et al., 2008), or pointing, drawing, annotating, reflecting, and talking (Ewenstein and Whyte, 2009). According to Ewenstein and Whyte (2009, 22) visual representations have almost an 'agential role' in showing what is 'lacking, wanting, and unfolding' in the sketches themselves. But how does this change when designers are using 3D BIM models? 3D models bring forth spatial elements which cannot be reduced to visuality alone. Especially when the models produced by each design discipline can be combined and seen from different angles.

The topic is also related to more general discussion on the nature, or materiality of digital objects. Digital object have a "dubious ontology" meaning that they have different features compared to physical objects (Ekbia 2009, Hui 2012). Still, digital objects are also material (Blanchette 2011). Materiality of digital objects (like BIM models of a building) is not about physical substance or "stuff" as such but something else (Leonardi 2010). The notion of "virtual materiality" can clarify what kind of tangibility BIM models are providing. Virtual can be defined by using a definition by

the pragmatist Charles Peirce according to which "A virtual *X* (where *X* is a common noun) is something, not an *X*, which has the efficiency (*virtus*) of an *X*." (Peirce 1931-1958, CP 6.372). For example, a BIM model of a building is not tangible in a same sense as the building itself but can have similar efficiency. BIM models used by designers are not yet "virtual reality" (which would simulate more also user's physical presence in an imaginery environment) but compared to traditional 2D models they have features close to virtual reality. The model, for example, looks much more like a real building and it can be looked from many angles.

In the presentation two long, face-to-face meetings are analyzed. There designers (architects, HVAC engineers, structural engineers, and representatives of contractors) used combined BIM models in a construction project of a renovated school in Finland. Five forms of expressions of indexicality and spatiality in the meetings were identified: 1) looking intensively at the BIM model on the screen, 2) demonstrative pronouns referring to the BIM model on the screen, 3) pointing with a finger or with a laser pointer at the model on the screen, 4) pointing with the cursor to certain places in the model, 5) moving the BIM model which included sub classes: locating, zooming, rotating, shifting, and cutting the 3D BIM model.

In the presentation I show results of the analysis in a more detail. At the end I discuss if and how these expressions of indexicality and spatiality provide tangibility and virtual materiality to the design collaboration compared to uses of 2D plans. An additional dimension of "concreteness" is that in the design work, BIM models operate as intermediary objects (see Vinck 2011) which are moulded and altered throughout the construction project. Virtual materiality can then be seen in many forms in the uses of BIM models.