Abstract of the PhD thesis

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This PhD thesis investigates the potential of using a digital representation of a facility in the form of a BIM model (Building Information Modelling) for facility management (FM), particularly during facility maintenance carried out to maintain and improve the durability and usefulness of the architecture.

The applicability of building information modelling extends far beyond the design phase. The BIM industry is developing increasingly sophisticated tools that can be used to create digital representations of buildings and offer an evolving range of functionality. In parallel, the standardisation of the BIM-based IFC format (Industry Foundation Class) is being developed for exchanging information between competing, as well as complementary, software. This opens the way for the use of the information contained in the building model in the other phases of the building's life cycle, for effective management of its operation, for example.

Facility management is analysed in this thesis as part of one of the stages of a building's life, i.e. operation and maintenance. On the scale of a building's lifespan, this stage takes the most time and, as research confirms, generates the greatest costs, so any attempt to optimise it can contribute to significantly prolonging the life of the building in use. The complexity of facility management depends strongly on the size and function of the building. In the case of large building complexes such as universities, the numerous tasks involved in the maintenance of a building require the involvement of many people. The desire to optimise an organisation's operating costs and the level of sophistication of some of the equipment in the building mean that some tasks may also be outsourced to external specialised contractors. Installations that support the functioning of a building are usually hidden from the building's users, so service work on these elements requires knowledge of their specifications, as well as their location and how to access them. Although facilities management has been applied in practice for years, it still hasn't exploited the full potential that it can develop in combination with the information contained in the BIM model.

One of the objectives of this dissertation is to develop a new tool (computer program)

to support building management based on BIM technology, working independently of commercial BIM programs. The support is understood as an enhancement of the movement around the building by means of a map with the shortest path drawn between selected points. With the help of this tool, the spatial structure of the building is read out from a building model saved in a standardised IFC format, on the basis of which the user can indicate a starting point and an end point, between which the shortest route is then determined. Work on the aforementioned original program was carried out in two software environments. The first stage was aimed at creating a support tool and was carried out using the Dynamo environment, which is used for visual programming and is directly linked to the Autodesk Revit software which is designed for the creation of BIM models. This tool made it possible to develop a scheme for the application, and then to carry out a series of studies related to the selection of the optimal way to determine the shortest route in the facility by comparing the results obtained by two commonly used methods of space analysis for routing, that are, the method using a matrix of points and the method operating on a visibility graph. Based on the results obtained, requirements were developed for a targeted tool for finding the shortest path between given points, written in the Python programming language. A stand-alone program was created in which the user, using a graphical interface, selects the starting and target points on the building plan, and in the final effect obtains a map, i.e. an outline of the room plan together with the shortest route between the selected points. The previously mentioned assistance tool based on Dynamo was used to verify its correctness.

The application was subjected to validation tests, which confirmed that it worked as initially intended. A user manual was also prepared in order to describe the use of the application from the user level.

The research confirmed the research potential in combining architectural issues, considered in the context of modelling information about the building and in the context of modern facility management tasks, with the informatization of elements from the whole building life cycle.