

# STUDENT EXPERIMENT WITH WALKING PATHS APPLICATION

**BIM**  
Portal Twente

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vernieuwt de bouw  
**pioneering**

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## 1 Purpose of this document

This document presents the results of an experiment conducted with 29 students from the Methods and Strategies for Facility Design course at the Civil Engineering Bachelor from the University of Twente.

## 2 Experiment goals

The experiment tested a method for creative problem-solving applied to facility design and a BIM application to optimize the walking paths of nurses and patients in a healthcare facility. The facility in question is a medical imaging center being built at the University campus. The goal was twofold: to test which creative problem-solving method performed best and to test if the BIM application supported the solution of problems related to workflow and spatial design.

## 3 Problem

The project's business case specifies the diagnosing machines that will be available and the amount of patients to be treated per year in each machine. The students were asked to optimize the facilities to meet these numbers.

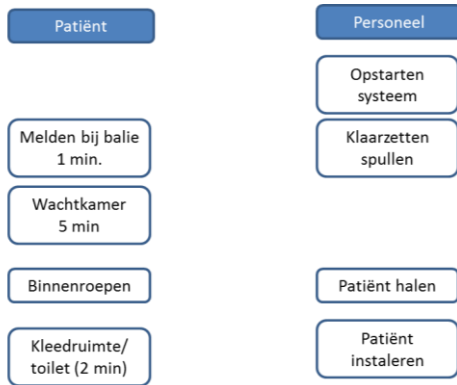
Machine productivity depends on the alignment of the spatial layout and healthcare logistics. The care procedures require specialized rooms for welcoming patients, let them wait comfortably, dress and undress, take contrast fluids, and other steps in the procedures. The arrangement of the rooms can, then, heavily impact work productivity and patient experience.

## 4 Experiment setting

The experiment had two sessions. In the first sessions, students received a printed copy of the floor plan and a creative problem-solving method (either PSP or TRIZ). Divided in groups of four, they identified problems and generated potential solutions.



In the second session, students worked alone to make changes to the floor plan using Autodesk Revit and evaluate their solutions using the BIM application, a customized family called Walking Paths. They received workflow diagrams designed by project managers. The diagrams don't specify in which room each step happens, so students had to figure it out.

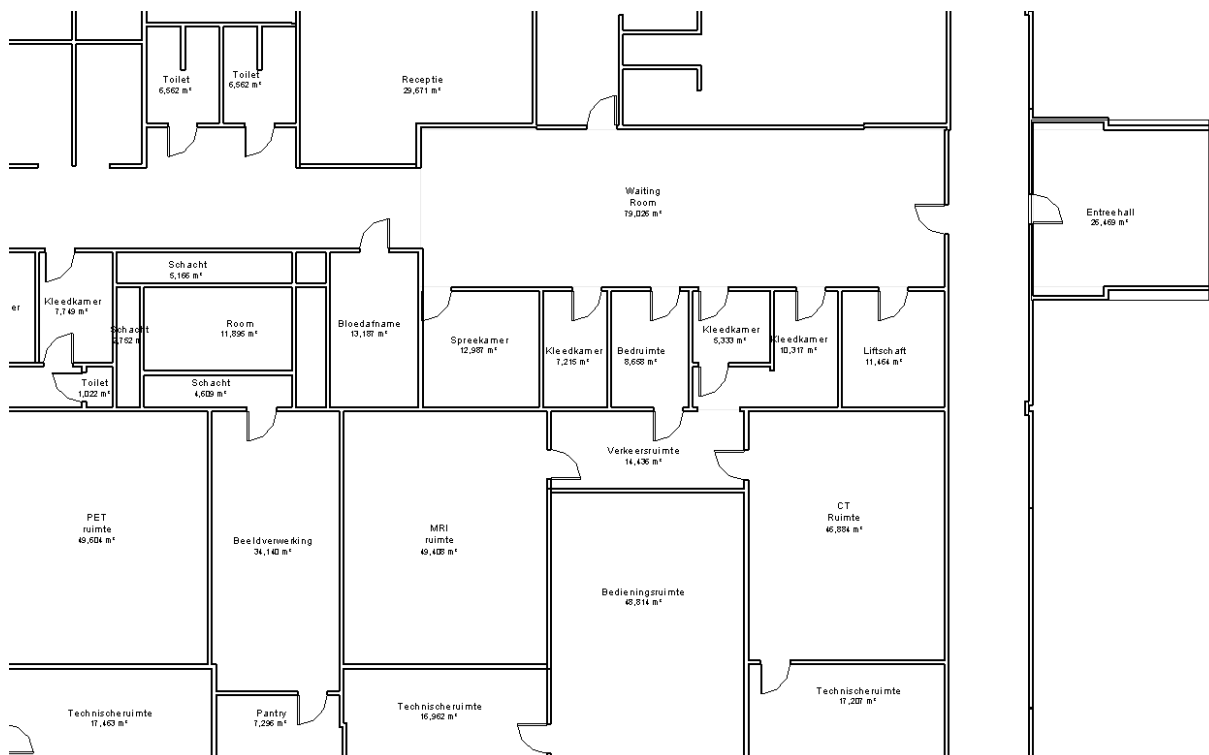


Based on this information, they were asked to draw the walking paths on top of the floor plan, using the provided custom family. While doing that, they could move walls, reassign the rooms, add and remove doors to optimize the paths. They had one hour in total to learn how to use the tool and fulfill the assignment.

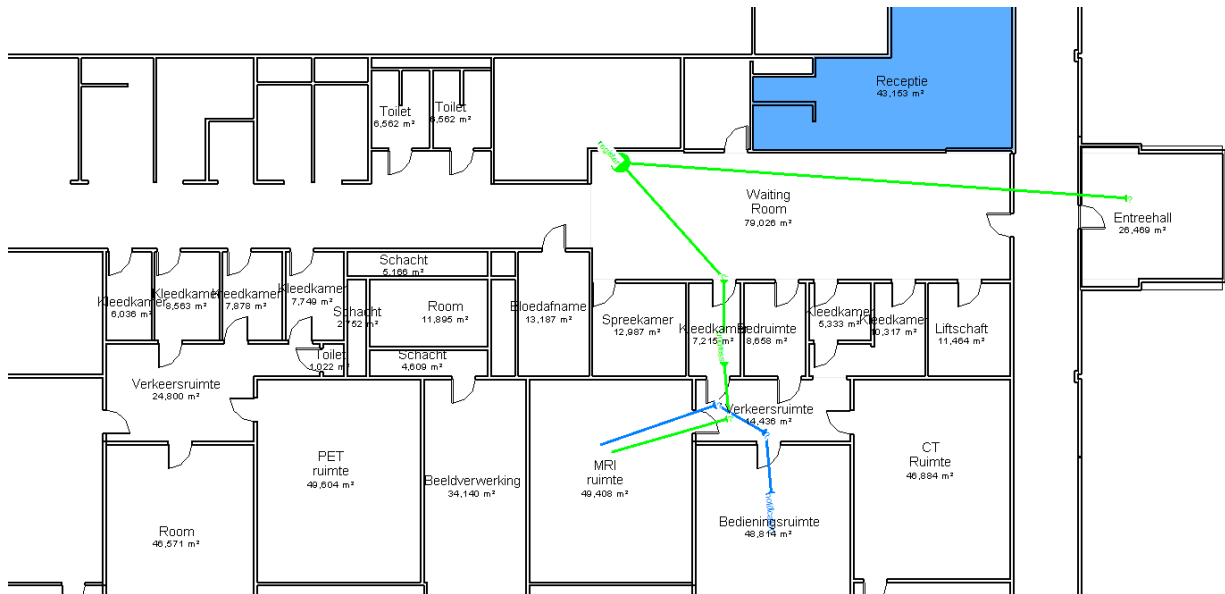
## 5 Results

For most students, the experiment was the first opportunity to use Autodesk Revit, so they struggle a lot to learn how the interface works. The first session helped identifying problems and possible solutions so they could, in this session, concentrate on learning the software and designing the solution.

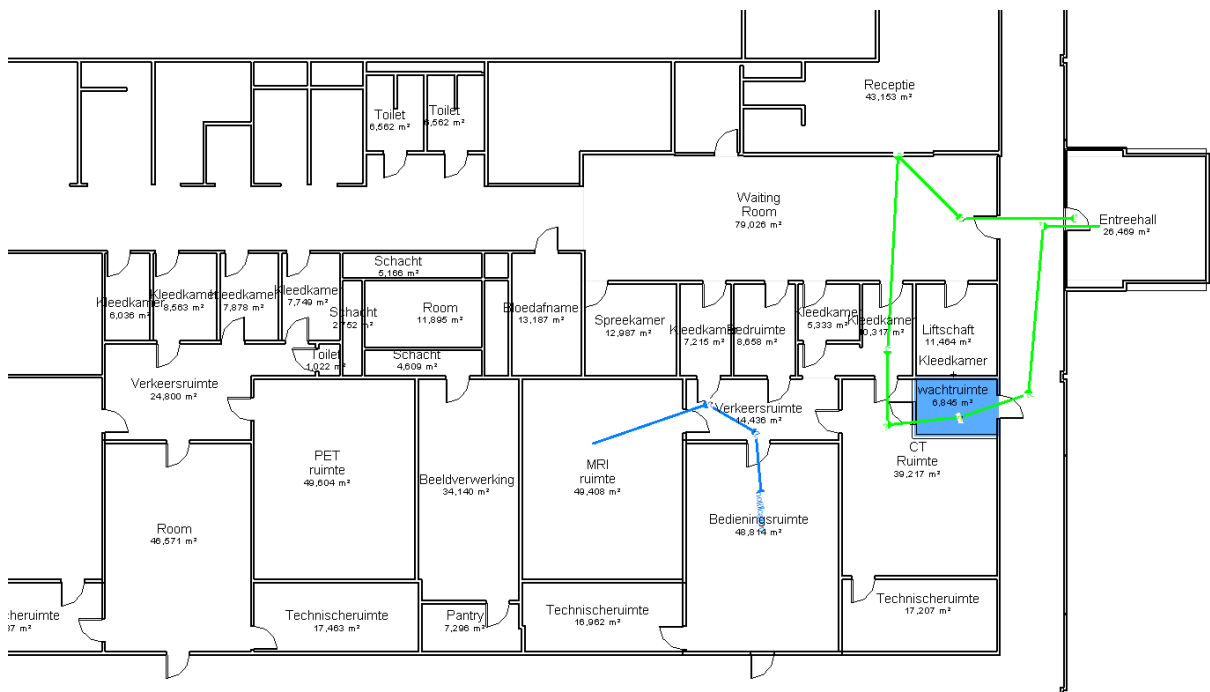
The interesting finding is that, by giving them a tool to visualize walking paths while adjusting the spatial layout, they adopted an evolutionary approach for design, making adjustments in the floor plan along the way they draw paths. That was the original floor plan they received in a Revit file:



One student started moving the reception desk next to the entrance. In the first session, many students identified the problem of entering the building and not knowing where to go, plus the extra walking distance if the reception was at the end of the waiting room.

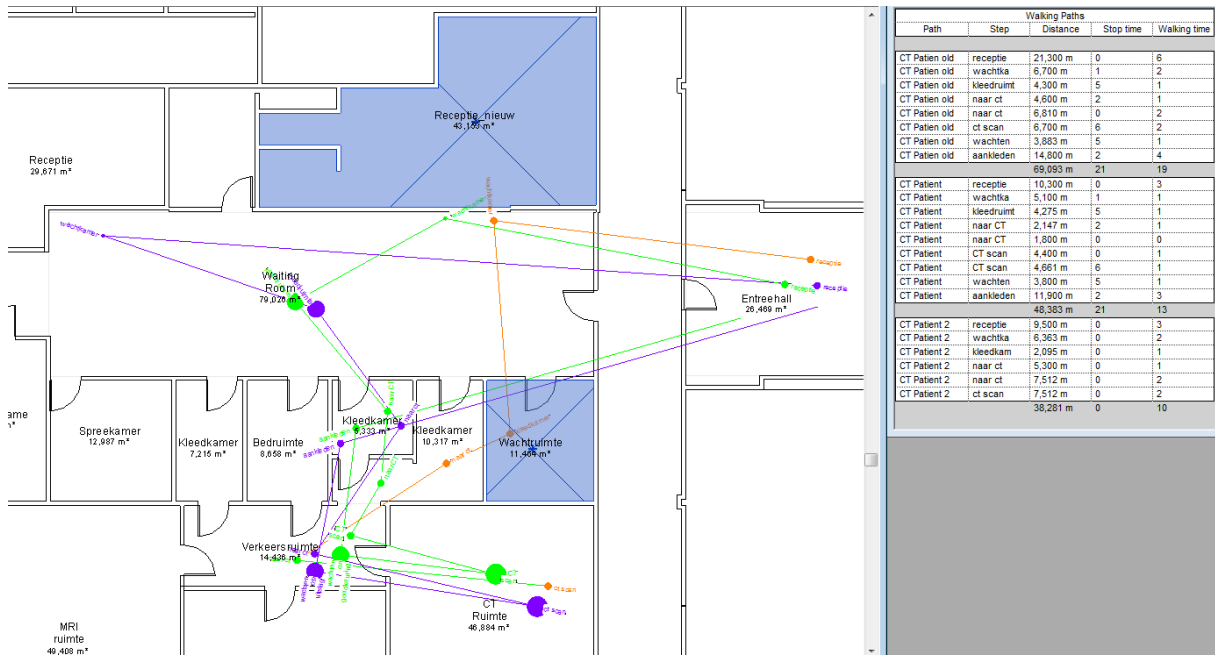


The layout is based on the waiting room as the central hub for the facility. Medical staff would have to walk back and forth to that place. Machines would be still while patients are walking towards them and undressing. In an attempt to solve these problems, this student added dedicated waiting rooms for the machines. He started with the CT machine, adding that the room could also be used for dressing and undressing.

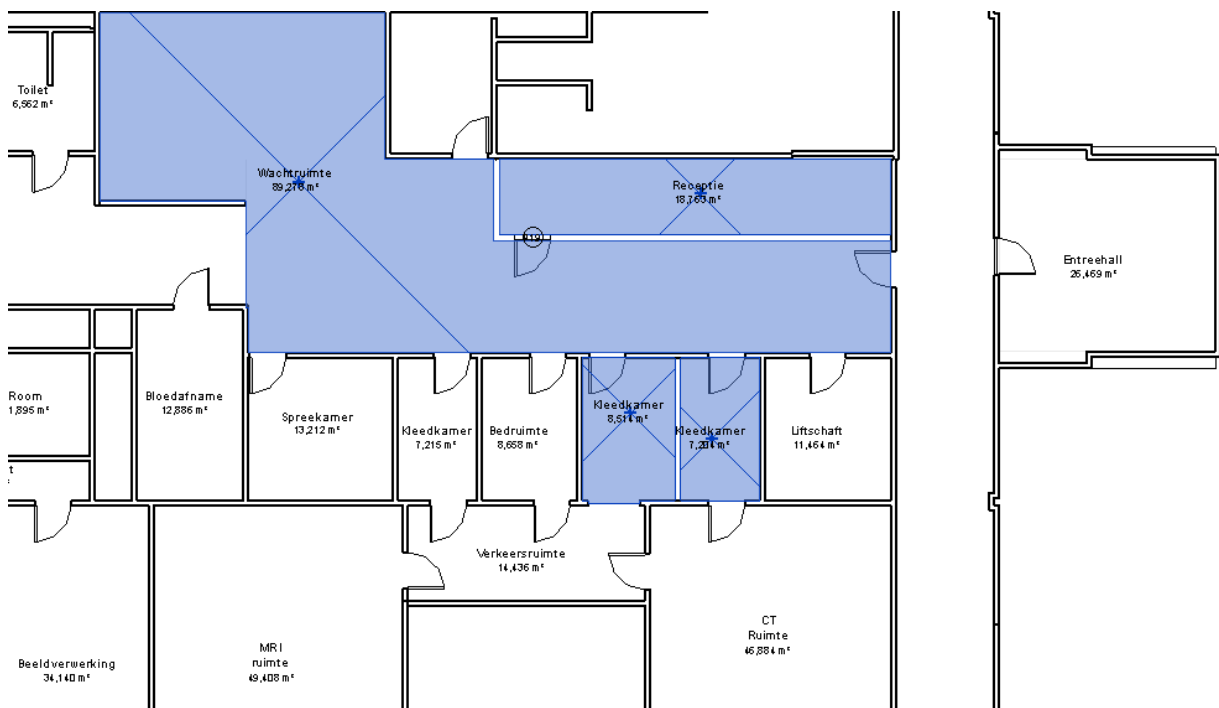


He combined the consulting room with waiting for the scan approval of the MRI machine.

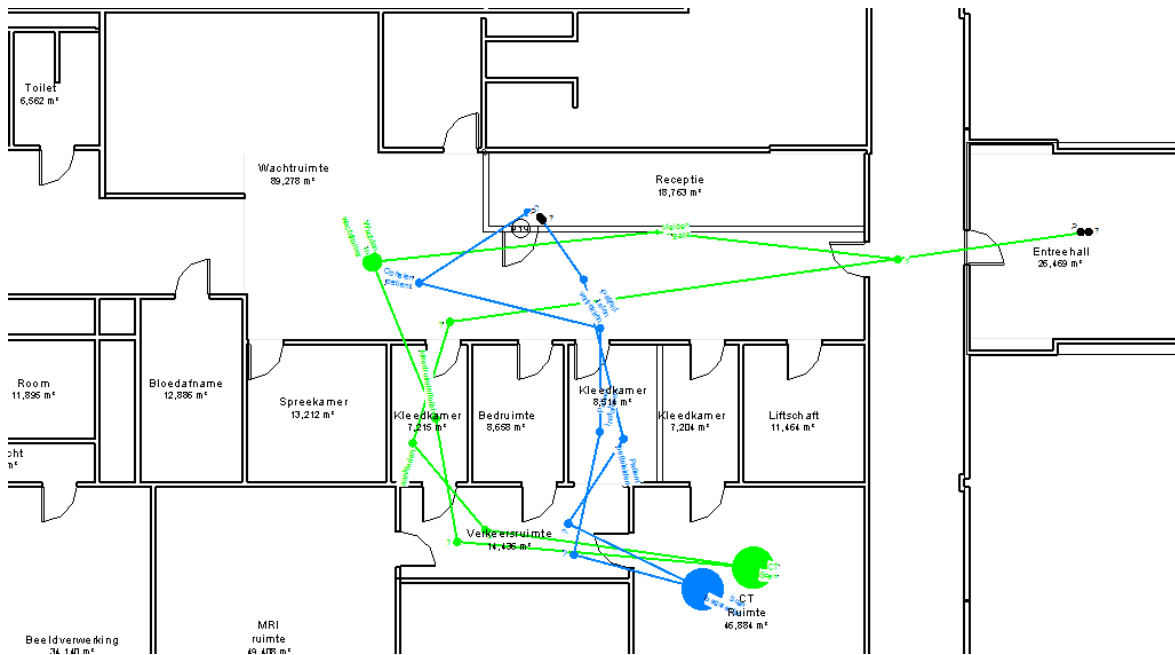




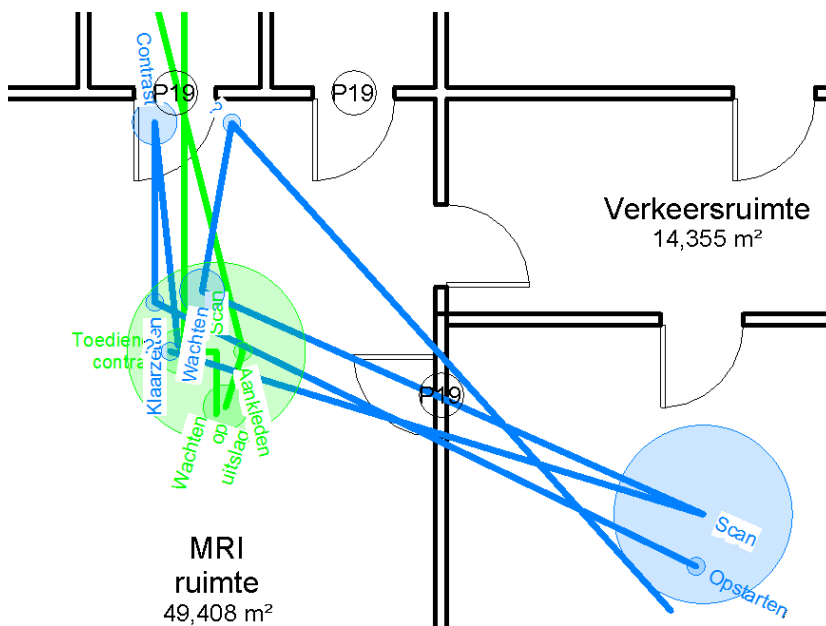
Student G.B. preferred first to make changes to the floor plan and then draw the walking paths. He designed a bigger waiting room and moved the reception desk closer to the entrance. He divided one dressing room so as to work dedicated to the CT machine.



For this student the walking paths were not used as input for designing the floor plan, but it helped to evaluate the plan in the end.



Most students didn't entered time duration in their walking paths. Student T.L. was an exception. He created two dedicated dressing rooms for the MRI machine and settled all the stop points in front of the machine. We can see from the image below that although there is a lot of information packed in one point, the visualization is still readable.



## 6 Students comments

At the end of the second session, students were asked to write a report evaluating the use of the Walking Paths family for the specific situation introduced. These comments were selected because they give insights on the advantages and disadvantages of using such application.

\* \* \*



*“In general, the program is easy to use if you want to show someone how the design influences the walking paths of the people that use the building. For example in meetings with stakeholders, it can be used to show them the effects of changes.”*

*\* \* \**

*“The key problem with Revit regarding our design problem is that the overall process can’t be simulated in Revit. The timetable for patients, availability of rooms and nurses can’t be implemented in the Revit model. If a patient is in the MRI scanner, a nurse can’t welcome another patient for e.g. a PET scan at the same time. This can’t be seen in the floor plan with the walking paths. Only the first patient on a day can easily be simulated and look where the nurses are at the same moment, which room is available and which not. As the day progresses you the processes start to delay each other, but that doesn’t show in Revit. In small rooms, and checking in at the reception, Revit can’t simulate whether congestion occurs. Sometimes people stop walking and let someone else pass. This influences the walking times, but Revit isn’t able to simulate that.*

*Revit on the other hand can be very useful when creating/editing a floor plan and see the effects when you change something. Rooms in the hospital can be placed with specific measurements. It is also possible to place the walking paths so you get a clear overview of which routes cross each other. After the first floor plan is created it is easy to relocate different rooms so the arrangement of the floor plan can be optimized. It’s also easy to place doors and walls in the floor plan which are also adaptable.”*

*\* \* \**

*“The situation modeled is an ideal situation, where everything behaves as planned. There is no scenario for emergencies. Users of the building will not behave as the parameterization. The modeled walking paths are the ideal paths: patients or staff will not always follow them, because of the current situation and their own choices and preferences.”*

*\* \* \**

*“Applying the walking path method in Revit to the CMI structure floor plans, resulted in a quick visualization of the problems at hand. The combined floor plan and walking paths offer a very intuitive way to improve the interaction of the floor plan and the workflow in the building.”*

*\* \* \**

*“An imperfection of using Revit to find the optimal parameters for the medical facility design is the fact that people do not always walk following the perfect designed route. People are influenced by so called ‘mental maps’ (Mental maps). This means a person makes up an ‘optimal’ path in his mind when entering a room. This ‘optimal’ path a person makes in his mind is not necessarily the actual optimal path. Revit only describe the paths you describe, which are not the same as the mental maps described above.”*

Based on the comments collected during the experiment, the table below has been made to weight the added value and limitations of the BIM application:

Added value	Limitations
Improve workflow and the floor plan at the same time	Paths are ideal; they won't be followed exactly in that way
Can be used in stakeholder meetings to show the effects of changes	You cannot define the paths without having enough information about the procedures
Identify overlaps and busy crosses	Time is flattened; path intersection might not happen at the same time
Provide an overview of building use	Offer little details on how space is used
Provide measurement criteria for workflow optimization	Does not relate to standard occupancy measures
Integrated in the design environment	It is not easy to quickly modify paths
Display a list of rooms crossed by a path	Paths are not connected to rooms, so they do not move together with them
Can guide creating 3D walkthroughs	Do not display warning when crossing walls

## 7 Conclusions

Using creative problem-solving methods before getting hands onto the design tool helped students to concentrate their software use to a very specific purpose: designing the solution.

The Walking Paths family has shown useful to evaluate and shape the solutions, bringing objective criteria to distribute workflow around the facility in the most efficient way possible.

The interesting finding is that, by giving students a tool to visualize walking paths while adjusting the spatial layout, they adopted an evolutionary approach for design, making adjustments in the floor plan along the way they draw paths. Having walking paths available over the layout stimulate a constant reflection on the suitability of the designed solution to work-related problems.