wskazać osoby, które nawet w projektach dyplomowych nie do końca świadomie operują tymi narzędziami.

Druga sprawa: czy rodzi się nowy paradygmat architektury? W latach, kiedy używaliśmy ołówka nie było tak, że wszystkie domy miały kształt ołówka… Tak samo i teraz, to co się projektuje niekoniecznie musi wychodzić wprost z komputera. Formy, które tworzymy nie powinny wynikać tylko z możliwości narzędzia, ale powinny być wcześniej przemyślane i zaprojektowane. Powinniśmy z ostrożnością podchodzić do narzędzia, które jest bardzo potężne i może być niebezpieczne, jeśli jest używane bez namysłu. Moim zdaniem, jesteśmy jeszcze daleko od wykreowania nowego paradygmatu architektury.

Wracając do kwestii edukacji komputerowej, uważam, że praktyki architektoniczne, w miarę możliwości, powinny odbywać się w biurach, które używają narzędzi, o których dzisiaj rozmawiamy, myśląc o BIM-ie chociażby. Dzięki temu studenci poznaliby zarówno możliwości, jak i niebezpieczeństwa płynące z ich stosowania.

Wielu studentów po ukończeniu studiów pracuje w biurach architektonicznych zajmując się wstawianiem gotowych rozwiązań z katalogów detali do projektów. Oni de facto nie zajmują się projektowaniem. Może powinni być oni kształceni w innych szkołach, np. technikach architektonicznych, przygotowujących na wystarczającym poziomie do pracy na stanowisku kreślarza.

**Architekt Sławomir Kowal:** Może powinniśmy uczyć tworzenia gier komputerowych i kreowania wirtualnych światów w grach komputerowych, wtedy mielibyśmy wpływ na to jak młodzież jest przygotowana, żeby te światy tworzyć.

## DISCUSSION – SUMMARY

**Prof. dr hab. inż. arch. Wojciech Bonenberg:** The topic is very well chosen; it is very relevant. Perhaps more to our didactic purposes than to the real world, which, I think, still has to wait a bit for a full implementation of digital methods in practice, although we can already see the potential of those methods, especially in quick prototyping, which is in fact also beginning to be done in the production phase thanks to digital platforms.

I have a reflection on the beginnings of digitalizing the design process in Poland. I remember that as a young graduate of the Faculty of Architecture of the Silesian University of Technology working with Prof. Gawłowski I met Prof. Stefan Wrona, who was then a research assistant. He showed our students, and us too, how to draw circles and lines using computer programmes. This was received enthusiastically, almost as if it was something 'of Oz'. Now we can see how those experiments have progressed; it is very important that they are continued under Professor Wrona's supervision and have given so intriguing results. A question arises where they are supposed to lead us. On the Internet there is a very interesting initiative called open-source architecture, that is an architecture open to constant improvement thanks to adding further elements by people who do not own the copyright of the subsequent phases of the designing solutions. It functions a bit like the Linux system, which is improved by its users. For our meeting to result with something tangible, I would like to table the motion that our universities make their achievements in applying computer methods publicly available in an open-source system for training purposes. I think that a network of universities that would join such a project would perhaps be an answer to the question we have posed 'what next?'. It might be a small step, but a very constructive one.

**Prof. dr hab. inż. arch. Andrzej Baranowski:** Professor John Habraken in his book *Palladio's Children,* says: „In the past architects were monument builders, today they are shaping everyday environment". As he explains later, for him it was this change that was the revolution in the paradigm of architecture. He saw everyday environment as the place of action. I think that this is the point where the idea called, perhaps not very fortunately, 'sus-

tainable development' converges with a very 'husbandry' way of thinking about constructing buildings and their functioning.

One more thing I would like to mention is 'life cycle assessment'. This idea goes in the direction even less liked by architects, namely that when you design a building you also have to plan its deconstruction, in such a way that the *status quo ante* could be restored and the site could be reused. For now, this is rarely done, but we cannot escape it in the future. For this, you need a thorough life cycle assessment, including the issues of energy and waste. Because nature has no notion of waste; it was created by our civilization. I cannot imagine this kind of analysis being done with standard, traditional methods, without digital technology. So digitalization may also save the idea of sustainable development.

**Prof. zw. dr hab. inż. arch. Stefan Wrona:** Our task as university teachers is to train and encourage students to think in such a way. It is true that students do not like thinking about what happens next with architecture, especially about pulling down the building they are designing. In the past the problem of demolition and waste was partly solved by frequent wars. The Tenth-Anniversary Stadium in Warsaw was built of post-war rubble. This is a vitally important issue and a very difficult one to deal with in training. When we started to teach AutoCad the options of building blocks and attaching various attributes to them and later pulling them out was the least liked procedure in AutoCad that students had to learn.

My predictions about our universities is that some of the students, who are after all taught mathematics, technology and informatics already in high schools, will go in the direction that Dr Słyk has shown to us: they will experiment, make calculations, use advance computer tools. Some will chose a different path, which cannot be discarded: they will work intuitively like sculptors, influenced by impulse and emotion. Those will also be able to design using a computer and a 3D printer. But not all our students are fully prepared, technologically and psychologically, to design and model in this way. So I don't think it is possible at the moment to steer all schools in that direction, rather smaller teams in selected classes.

**Prof. nzw. dr hab. inż. arch. Jan Słyk:** In the second-life environment, a popular US platform giving access to a virtual reality in which people have an alternative life, there are thousands of architecture forms that make up the above-mentioned *open-source architecture* based on cooperation between units and users. This goes on in various ways and the boundaries of copyright are becoming very fuzzy, dangerously for architects.

**Prof. zw. dr hab. inż. arch. Stefan Wrona:** *Second-life* is a professional implementation, not a social one. There are of course new networking tools, such as Facebook or Twister, where registered users get hundreds of messages a day encouraging them to read some interesting information. Young people have adopted this way of communication. We cannot question this process although it may be difficult for some.

Professor Baranowski has mentioned that the building process has many phases and has to be viewed systemically, that it does not end when the house is put into use. In practice, it is not so now; for instance when developers sell flats, the responsibility of the builder ends when the flat is handed over to the user.

**Prof. nzw. dr inż. arch. Zbigniew Bać:** I want to refer to a paper recently published in *Akademia*, a quarterly of the Polish Academy of Sciences, where a sociologist argues that Poles' worst failing is individualization and that everything should be done to forge this individualization into community. In connection with the idea of setting up interuniversity teams, I must draw your attention to the copyright, which is a very delicate matter for us. I know that mechanical engineers, although they work in a different field, have been doing research in interuniversity teams for years. There are several institutes that explore the same topic, particularly important for their field at the moment; they meet and cooperate. Perhaps our meeting today can start off such cooperation in our field. This may be our future, only we have to put aside individualization for a moment and try working together.

**Prof. zw. dr hab. inż. arch. Stefan Wrona:** To initiate such an experiment we first have to discuss and prepare it.

**Prof. nzw. dr hab. inż. arch. Joanna Giecewicz:** I would like to link Prof. Saggio's fascinating lecture with what was said later. The term 'inverting the direction' is extremely important, and we are consid-

ering here whether a new paradigm is being born. If we look at how new paradigms are born, there are different ways: there may be a genius, someone exceptionally talented, or there may be very precise, perfectly prepared research leading to a complete reversal of rules. An example of the first category may be Buckminster Fuller, who devised extraordinary things, which everyone treated as impossible to implement, even though technically correct. Another example is Richard Foreman, who reversed the paradigm of planning in the 1990s, saying that the most important objective is to protect water and water-bearing areas, then protecting forests, then protecting agricultural areas, then creating infrastructure, and only the remaining areas can be built on. This was a complete reversal of the previous ideas. And it also shows how long it takes to start implementing such ideas. So I would like to ask about the role of education and academia in stimulating such radical changes in ways of thinking. I think that we have great opportunities, that the democratization of knowledge and tools allows students to participate in most demanding projects. Yong peoples' inventiveness is one of the best ingredients in those, as necessary as intuition. I have seen such a definition that intuition is the most filtered and most refined body of information that can be used. So it seems that academia should lead in this innovative thinking which sometimes induces radical changes. And this is totally contrary to the assumptions taken by our current governors of education and academia, who want research to be practical, to give quick results. If we don't do that, no one will.

**Prof. zw. dr hab. inż. arch. Jan Maciej Chmielewski:** I would like to add some reflections. One is on a whole that is more than a sum of its component parts. A question then arises whether a whole has got limits. Looking systemically, on can always say that any system is set within a higher-order system and is divided into sub-systems. Thus, within a systemic approach we no longer view the building process in a linear fashion: designing, constructing, using. One could say that the last phase should be transformation, because it perhaps encompasses everything that is part of spatial planning. Prof. Saggio mentioned returning to areas already developed which are then restructured. Such a transformation is natural in urban planning but we should consider whether it should not be also applied on a single-house scale.

There is also the question whether designing precedes building or overlaps with it. We could say that the building process continues until the house lasts. Looking systemically, we can perhaps depart from this linear view of certain things and take a wider perspective.

And I would like to say something about multifunctionality. In urban planning multifunctional structures are very common. Perhaps multifunctionality will start to emerge clearly in architecture as well. The way a structure is used results in some parts becoming multifunctional. It seems to me that this kind of multifunctionality is more and more noticed in architecture not only in urban planning. This is an interesting systemic view of those processes.

**Prof. zw. dr hab. inż. arch. Stefan Wrona:** The functions of a building can never be treated as a fixed value, because the function is never assumed to be unchangeable. As to the linearity of the building process, there is positive feedback involved, which was clear in the presentation. After the phase of use there is wear and tear, and we come back to the design and building phases, and this cycle recurs, though on a smaller scale.

**Prof. nzw. dr hab. inż. arch. Jacek Gyurkovich:** We have heard three very interesting lectures on extremely hot and important topics. The short history of the development of computer-assisted designing shows that using digital systems of information storage and processing is becoming a necessity in both training and professional practice. If this is supplemented with talent, we have a chance to create intelligent cities, innovative and inspiring architecture.

**Architekt Sławomir Kowal:** The first phase of computer training was only to teach students how to use programmes, for instance to produce two-dimensional drawings. This was not a change in thinking about design yet. The same goes for 3D modelling programmes, their application did not really change the teaching methods. We simply taught students programmes that were used to make 3D models to replace traditional scale models.

Training in BIM programmes is very difficult and cannot really be done theoretically. Those programmes must be learnt through working on real projects.

Changes in the training system are necessary because of the Internet, which changes society so rapidly. We are trying to catch up with the young, because they have been born with 'a keyboard under their pillows'. It is only what Dr Słyk was talking about, parametric design, that marks an evident change in thinking, if we have access to tools, and in this case we often make our tools ourselves, also through open sourcing. It has a vast didactic power, which was so greatly illustrated by my colleagues. I can see an enormous potential here but of course we cannot predict not how things will develop.

**Prof. zw. dr hab. inż. arch. Stefan Wrona:** This systemic concept developed in the 80s and 90s, it was a certain idea. Holism was a kind of world-view open to the environment. But it had a drawback, there were no tools to implement it. It is only computer tools, so rapidly developing now, that make this old idea more realizable. BIM is another tool which promotes and enhances the systemic approach. It reminds us that designing has to be viewed very broadly.

**Prof. dr inż. arch. Antonino Saggio:** To bardzo ważny temat. Jeśli dobrze zrozumiałem, można powiedzieć, że projektowanie parametryczne i Internet są bardziej innowacyjne niż BIM. Ale myślę, że trzeba na sprawę spojrzeć z innego punktu widzenia. To co dziś nazywa się BIM było dostępne jako implementacja od lat siedemdziesiątych, a niedawno, 5-6 lat temu, weszło do AutoCada jako Revit. Pomysł istniał. Ważne jest to, że dzięki temu podejściu powinien powstawać nowy rodzaj architektury. Wielka wartość tego narzędzia polega na tym, że zmieni nasz sposób myślenia i popchnie nas w stronę kreowania architektury odpowiadającej narzędziu.

Dam prosty przykład. W technologii informatycznej blok to element interaktywny używany do manipulacji różnymi cechami. Jeśli zastosujemy pomysł bloku, żeby odtwarzać taki rodzaj architektury, jaki znamy, to jest statyczne, a BIM to tylko implementacja. Cechy BIM muszą zostać wprowadzone do samej architektury, czyli architektura musi stać się podobna do BIM, interaktywna, elastyczna. Procesy właściwe naszemu narzędziu powinny się przenieść na samą architekturę. Choć wydaje się to banalne, zajęło mi wiele lat, żeby to sobie uświadomić. Tak naprawdę to narzędzie jest wyzwaniem, szczególnie w nauczaniu; przede wszystkim to jest narzędzie dla fachowców, nie wyzwanie intelektualne. Myślimy o architekturze nowej generacji, o nowym paradygmacie, który wykorzysta potencjał otoczenia.

Jeśli spojrzymy na historię, zawsze tak było. Idee industrializacji przenikają do architektury od 100 lat; dopiero teraz zaczynamy myśleć o architekturze jako maszynie. Więc niektóre procesy, które obecne pokolenie poznało dzięki industrializacji, wpłynęły na powstanie nowej koncepcji architektury. Przejście od architektury gotyku do renesansu opierało się na perspektywie, a pojęcie perspektywy to narzędzie intelektualne. Dla mnie to jest podstawowa sprawa, że to narzędzie powinno zmienić samą architekturę, nie tylko jej tworzenie. Jest potrzeba stworzenia architektury nowej generacji, a narzędzie jest nie rozwiązaniem, ale wyzwaniem dla użytkownika. Technologia pozwala nam tworzyć architekturę interaktywną, żyjącą, elastyczną.

**Prof. zw. dr hab. inż. arch. Sławomir Gzell:** I'd like to comment on computer training in our Faculty. Before they get enough practice in computer programmes students are often hampered by the machine since they cannot fully express their architectural visions in computer drawing and 3D models. From the very beginning we should teach them designing which is not limited to software use. Towards the end of their course most students are proficient enough in computer-assisted design, although we could also easily find people who do not use this tool consciously enough, even in their graduation works.

Another issue: is a new paradigm of architecture being born? At the time when we used pencils to draw it was not the case that all houses were shaped like pencils. This applies now as well: not everything that is designed has to come straight from the computer. Forms that we create should result not only from the capacity of our tools but also from previous thinking and planning. We should approach such tools with caution; they are very powerful and can be dangerous if used without proper consideration. I think we are still far from a new paradigm of architecture.

Coming back to computer training, I think that student practical training should be done in companies that implement tools we talk about today, e.g. BIM. This would give students an opportunity to discover both the advantages and the dangers. Many of our graduates join designer teams and work by

simply entering ready solutions from catalogues of details into schemes. This is not really designing. Perhaps they should be trained in different schools, technical colleges, which give enough training to work as a skilled draughtsmen.

**Architekt Sławomir Kowal:** Perhaps we should teach how to make computer games and create virtual worlds in them, then we would have some influence on how the young are prepared to create those worlds.

Translated by Z. Owczarek