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REVIEW

Sapere Aude: Professor Edmundas Kazimieras Zavadskas

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Professor E. K. Zavadskas' 65th Jubilee serves as a pretext not only to present his academic and scientific achievements, but also those of his colleagues. The Professor's most characteristic distinctions and awards have been quoted. His contribution to development of integral humanism, as well as to development of international academic collaboration has been discussed. A review of publications characteristic for the Professor and focus of his research has been given. The entire body of information is discussed within the context of the last trans-border Colloquium, in the Lithuania-Germany-Poland triangle, on *Sustainable Development in Civil Engineering and Multi-Attribute Decision Making* in Vilnius, May 20-23, 2009.

In the Vilnius Gediminas Technical University logo there is an inscription quoting Horatio's words: "Sapere aude" – *Dare be Wise*. These words constitute a perfect definition of the traits and character of Professor Zavadskas, whose jubilee we are celebrating this year.

Professor Zavadskas is celebrating his sixty fifth birthday. He was born on the twelfth of May 1944 in Vilnius. His openness and unlimited view of the world, backed up by extremely hard work and intelligence, created his undisputable position of authority, and manifested itself in writing numerous books, not only touching upon technical subjects, but also didactic, philosophical, ethical, and political matters. Those books have been published also in foreign languages.

The Professor's achievements have found appreciation in numerous publications. There are attempts of a synthesis of his academic heritage in numerous publications by the following authors: Lujaniene and Jursaite (1998), Nakas (2002), Bartkiene and Jursaite (2009) and in a monograph by Liekis (2004). The monograph quoted 70 published books written by the Professor; 26 books touching upon political, philosophical, and social issues; 355 articles on construction; 133 academic-didactic publications; 299 polemic articles, and 131 interviews given to the media. Including the quotations, the monograph embraces as many as 3754 items.

The first publications were on gypsum technologies. This was also the subject of his first publication in Lithuanian (1965). The first book (brochure) publication was issued in 1973 as the material meeting didactic needs (in Russian). PhD was granted to him in 1973: he researched the applications of polymer resins in reinforced concrete. This was the time when he took interest in optimising constructions, technologies, and organisations. Selection of solutions dominated his research. This is how he significantly developed some elements of rational decisions theory. A monograph is a summary of his achievements from that period (Zavadskas 1987). This monograph has had a strong influence on research conducted by young academics working towards their PhD theses in a number of countries, from Uzbekistan through Russia, Poland, Germany, Denmark to Syria. Another monograph (Zavadskas 1991) strengthened the Professor's position as a leader in this part of Europe winning the area of multicriterion decision aiding methods, and operational research application in construction industry.

Synthetic work on multicriteria decision support systems in construction has been published in individual monographs (c.f. Kaklauskas and Zavadskas, 2002; Zavadskas, 2000), or in collaboration with the Lithuanian colleagues (c.f. Ustinovichius and Zavadskas, 2004; Zavadskas and Kaklauskas, 1991, 1996, 2007), from Germany (Zavadskas *et al.*, 1994) and Denmark (c.f. Zavadskas *et al.*, 1992). The methods originating from this area have been continuously perfected (see: Ginevicius *et al.*, 2008a, b; Ginevicius and Podvezko, 2009; Sivilevicius *et al.*, 2008; Turskis, 2008; Turskis *et al.*, 2006; Sarka *et al.*, 2008; Ustinovchius *et al.*, 2007; Zavadskas *et al.*, 2006). New methods for performing multiple criteria analysis of a project have been developed by Professor's team, including:

- a method of complex determination of the significances of the criteria taking into account their quantitative and qualitative characteristics (COPRAS) (Kaklauskas *et al.*, 2006a; Zavadskas *et al.*, 2004a), applying attributes values determined in intervals COPRAS-G (Zavadskas *et al.*, 2008 b, c, 2009a) and applying fuzzy sets COPRAS-F (Zavadskas and Antucheviciene, 2007);
- a method of multi-objective optimisation on the basis of Ratio Analysis – MOORA (Brauers and Zavadskas, 2006).

Those methods had their practical applications. COPRAS and MOORA methods where used for multi-attribute assessment of road design solutions (Zavadskas *et al.*, 2007a, 2008d; Kalibatas and Turskis, 2008; Brauers *et al.*, 2008a), and for evaluating the sustainability of Vilnius-city residential areas (Kaklauskas *et al.*, 2007b; Zavadskas *et al.*, 2008b). Another group, supervised and directed by the Professor, has applied the whole set of multiple criteria optimisation methods for modelling the facilities of management alternatives (Brauers *et al.*, 2008b; Brauers and Zavadskas, 2009; Lepkova *et al.*, 2008; Zavadskas *et al.*, 1999, 2001, 2007b; Zavadskas and Vilutiene, 2006; Zavadskas and Burinskiene, 2007; Zavadskas and Kaklauskas, 2008a). That group includes also German, Estonian, and Polish colleagues who have collaborated with the Professor. A review of this work has been quoted in the work by Zavadskas (2008b). All the details of the methods have been perfected, and an example of that is expert investigation methods (c.f. Kaklauskas *et al.*, 2005a, 2006b). New multiple criteria analysis methods (construction on-line systems) are prepared by Kaklauskas *et al.* (2007b). Computer software to solve multicriterion problems was designed within the framework of German-Lithuanian collaboration (c.f. Zavadskas *et al.*, 2003; Turskis *et al.*, 2009).

The problems of balancing of construction processes under unspecified conditions played an important role in research, especially in international collaboration. They consisted of applying models based on games theory (Zavadskas and Vaidogas, 2008, 2009). What is worth noting in this context is the collaboration with Professor Peldschus (Peldschus, 2008; Peldschus and Zavadskas, 1997, 2005; Podvezko, 2008; Zavadskas *et al.*, 2004b). Normalization methods in games theory and multicriterial approach were further developed (for example, Brauers and Zavadskas, 2007; Zavadskas and Turskis, 2008; Zavadskas *et al.* 2008c, f; Turskis *et al.*, 2009).

Parallel to the above, artificial intelligence methods were developed and implemented. Among those, expert systems, are very important: Zavadskas et al. (1995); Kapliński and Zavadskas (1997); Kaklauskas et al. (2005b, 2006b); Banaitiene et al. (2008); Zavadskas et al. (2008a); Urbonaviciene et al. (2009b). A need of application of hybrid solutions has been strongly suggested. It resulted in developing a hybrid advisory system, and its application in assessment of repairs of industrial flooring (Gajzler, 2008).

All methods listed in the above review found their applications in such areas as: sustainable development in civil engineering, building live cycle, e-learning, transformation of economy (for example: Antucheviciene and Zavadskas, 2008; Brauers et al., 2007; Brauers and Zavadskas, 2008; Ciegis et al., 2008; Kaklauskas et al., 2007a, 2009a, b; Kaklauskas and Zavadskas, 2008; Mickaityte et al., 2008; Sliogeriene et al., 2009; Urbanaviciene et al., 2009a; Ustinovichius et al., 2006; Zavadskas et al., 2001; 2008e; Zavadskas and Antucheviciene, 2006, 2007; Zavadskas and Kaklauskas, 2008b; Zavadskas and Vilutiene, 2006; Zavadskas et al., 2009b, c).

The Professor has completed a review of his own, and his international colleague's work in a number of editorials. The examples are as follows: Brauers and Zavadskas, 2007; Zavadskas, 2005, 2008a, d; Zavadskas and Burinskiene, 2007; Zavadskas and Kaklauskas, 2001, 2008a.

Currently, the Professor is in charge of two major subject areas in VGTU's Construction Technology and Management:

- Web-based decision support in economy, business and management.
- Application of operational research methods for construction and real estate valuation.

Research works are the following ones:

- Multicriteria decision support systems in construction.
- Overall quality control of projects.
- Modelling and prediction of development of construction areas, housing and real estate sectors,
- Energetic reliability in constructions.
- Building systems and prediction of their development in future. Energy input economy and alternative energy.
- Efficiency of investments in constructions.

No wonder that the jubilee is accompanied by another 12th Lithuanian-German-Polish Colloquium. It was the Professor who was the founder of those conferences. The first event took place in Leipzig in 1986. Subsequent conferences took place every two years in different academic centres participating in the project. Reports form Colloquia, and academic achievement reviews have been published (see: Kapliński, 2000; Zavadskas and Kaklauskas, 2001; Kapliński and Zavadskas, 2002; Kapliński et al., 2004; Kaklauskas et al., 2005a; Zavadskas, 2008b).

There has been not a trace of xenophobic atmosphere at those conferences, not a single political undertone. They are an example of good collaboration in the exchange of research information, consultation of publications and promotional papers, their reviews, collaboration on joint publications, developing planning tools in the area of civil engineering and construction projects. At the beginning, the subject matter dealt with games theory, multicriterion optimisation and reliability; now the dominating subjects include DSS, artificial intelligence, life cycle of objects, facility management and, first of all, IT applications. More than 200 articles and 40 books are the fruit of this collaboration, published mainly in Germany and Lithuania. Professor Zavadskas has introduced many elements of new approach to selecting design and implementation solutions and, primarily, in the area of multicriterion optimisation. He has developed MCDA and MCDM methods, and his original ideas have inspired dozens of PhD dissertations in Lithuania and in other countries.

Our Colloquia are saturated with the spirit of integral humanism. It was Professor Zavadskas, at the helm of the academic vessel of Lithuania, with enormous influence on academic communities, and Central and Eastern Europe in particular, who noticed and talked about negative effects of technical and scientific revolution which might be disastrous without simultaneous scientific-humanist revolution. He pointed at social philosophy known as socially involved personalism. He tried to teach us to think in terms of academic community. He took up a task of creating order within academic communities which would synthesize the extremes (of social capital and social individualism) into a balanced entity based upon the philosophy of integral humanism. It is, therefore, no wonder that this subject has become a foundation of the Professor's speech on "University and Integral Humanism" during the promotion of his first Honorary Doctorate at the Poznan University of Technology (January, 2002).

Professor Zavadskas has been granted a title of a Honorary Doctor of three universities: Poznań, (Dlugosz, 2002) Kiev, and St. Petersburg (2001 – 2003). He presides and participates in a number of scientific corporations and editorial boards of scientific publishing houses. He is a member of Lithuanian Academy of Sciences, a member of two Russian Academies, the Ukrainian Academy of Cybernetics, and many (17) scientific and research organisations, from Melbourne to Brussels. He also represents Baltic States in international organisations.

After a long international collaboration between researchers from several European countries (Lithuania, Germany, Poland, United Kingdom, Belgium, Denmark, Latvia, Estonia, Czech Republic, Slovenia) the decision to establish Working Group "OR in Sustainable Development and Civil Engineering" was taken. Under the initiative of professor Zavadskas the Working Group was established during the 23rd European Conference on Operational Research "OR Creating the Competitive Advantage" EURO XXIII (Bonn, 2009) (http://www.euro-online.org/display.php?file=wg_info.php&wgid=32&title=EWG-ORSDCE,-WS-OR-WS-in-WS-Sustainable-WS-Development-WS-and-WS-Civil-WS-Engineering& parent =303)

The Professor has been twice awarded the state award on a science (1996, 2004).

Granting the Professor the Order of Grand Duke Gediminas was an expression of enormous appreciation. He was granted the first scientific honour (PhD) in 1973. And his road to numerous prestigious honours required intensive work, and led him even through Vorkuta. Celebrating his birthday today, the Professor, has special links with academic communities in Poland. Polish professors are often invited as members of PhD committees and as members of editing boards, or organisational committees of conferences in Lithuania. Those contacts intensified when the Professor was the Rector – initially of VISI, later transformed into VGTU.

His influence on the development of good relationships with Poland is clearly visible in the fact that Prof. E. Zavadskas was one of the founders of the Adam Mickiewicz Foundation an organisation working towards the amendment of relationships between Lithuania and Poland. He also collaborates with parliamentary groups in both countries. In 2004, he was honoured with the Award of Polish and Lithuanian Parliamentary Assembly. He is a laureate of the 'Integral Humanism' Medal, awarded by a Polish magazine 'Lithuania' and a Lithuanian magazine 'Culture'. In 2001 he was univocally elected as a member of the Civil Engineering Committee of Polish Academy of Sciences.

It is virtually impossible to quote all Professor's achievements in such a short paper. They have all been published in special publications - see the last monograph (Liekis, 2004).

The facts quoted here prove his prestigious position, and they have become the measures of his achievements, but do not state that the Professor discounts his past. On the contrary, those facts are living proof that the Professor looks into the future. In recent years, he took up a task requiring patience of a monk – he has been working towards increasing the academic level of periodicals, especially in Lithuania. As the editor-in-chief, he introduced those periodicals in a group included into ISI Web of Science. The periodicals under his management are now open to the authors from Poland and neighbouring countries. This is how the Professor influences and inspires Polish academics, especially those involved in Construction Management and Engineering – see for example: Dziadosz 2008; Hajdasz, 2008a, b; Janusz and Kapliński, 2006, 2007; Kapliński, 2008a, b, 2009a, b; Karłowski and Pasławski, 2008; Meszek, 2007, 2008; Pasławski, 2008a, b, c; 2009; Thiel, 2008a, 2008b. There are also published reviews of those works – c.f. Zavadskas, 2008c. The Professor facilitates academic promotion of his colleagues from Poland.

On the day of his jubilee, we would like to congratulate the scientist of the greatest format, a proven friend of our nation, the person whose merits and contributions to the development of international collaboration of academic communities in the spirit of integral humanism are numerous. Professor Zavadskas is an icon of construction, research, and international collaboration.

On his Jubilee, we wish him all the best, lots of success, and most of all satisfaction from witnessing success of his alumni, and of many of his colleagues from abroad.

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