Interview with Professor Emeritus Alessandro Birolini - a Guru of the European Reliability

Alessandro Birolini was born on the 13th September 1940 in Lugano, Switzerland and is presently Professor Emeritus of Reliability Engineering at the Swiss Federal Institute of Technology (ETH) Zürich, which is itself a pole of excellence in science and technology and is ranked among the top universities in the world.

During more than three decades Dr. Alessandro Birolini brought an important contribution to the development of reliability, to its recognition as important domain of interest in the engineering and academic fields, not only in Switzerland but in the entire Europe. The international cooperation developed by Professor Birolini as Director of the by him created Reliability Laboratory at the ETH Zürich, the important number of international conferences and symposia in this field organized by Professor Birolini in his laboratory in Zürich (which became a veritable European pole of excellence in this field) entitle the opinion of several international experts in the field to consider Professor Birolini as a veritable "Guru" of the European reliability. Engineer and philosopher (or "*Ingenieur et penseur*" - as he defined himself on the cover of his remarkable book *Reliability Engineering: Theory and Practice*), Professor Birolini brought an important contribution to the development of theory and practice of reliability, to its recognizing as a university domain of education and research. I had the opportunity to work, during short periods in 1993 and 1994 as an Invited Professor at the Reliability Laboratory of

the Swiss Federal Institute of Technology (ETH) Zürich, when I presented a short course on the "*Dependability of Complex Systems*". I had the extraordinary opportunity to work during this period with Sandro Birolini and I was impressed not only by his professional stature, but also by his human stature. Indeed, Professor Birolini is not only an excellent manager and specialist in Reliability field, but a man of an exceptional integrity, kindness and modesty. Several honors gather to crown his exceptional career: Alessandro Birolini is a Life Member of the Swiss Academy of Engineering Sciences, an Honorary Member of the Romanian Academy of Sciences, Life Senior Member of the IEEE, Recipient of the IEEE Third Millennium Medal, etc. Professor Birolini was President of the Swiss Information Technology Society and Chairman of the IEEE Switzerland Section as well as Founder and Chairman of the IEEE Switzerland Reliability Chapter a.o.

1. Prof. **Ioan C. Bacivarov (I.C.B.)**: Referring to your speech at the launching of the 8th English edition of your book *Reliability Engineering* (Springer), I would like, as at the CCF 2010, to go deeper in your professional and somewhat also personal life. You were born in the Italian part of Switzerland, which makes only something more than 5% of the Swiss population; how large was the influence of this membership to a small minority on your formation, professional and human?

Prof. Emeritus **Alessandro Birolini (A.B.)**: Switzerland is a very old confederation, started 1291 with a pact between three small countries just at the north side of the Gottardo pass and extended step by step to form 1815 the today Switzerland. Based on this long tradition, minorities are respected and more than this well accepted, when integrated. Switzerland is a confederation of republics with larges autonomies, a typical example as Europe should be. So, with Italian mother language in Switzerland we must accept to be a minority and to move toward the French or German majority, beginning by learning the language, to have greater formation and/or professional opportunities. It must be noted that learning, and accepting, another language and culture is an enrichment.

2. I.C.B.: Which where then the main steps in your formation and in your professional life?

A.B.: Coming from a family with limited financial resources, the only possibility was to start learning a job which would allow me to work during the study. Here are the main steps in my formation and professional life:

- After an apprenticeship as an electrician, a Bachelor's degree at the Technicum Cantonal de Fribourg (near Bern) and a Master's degree in electrical engineering at the Swiss Federal Institute of Technology (ETH Zurich), I was a research assistant at the ETH to achieve the Ph.D. degree in 1974.
- Following 5 years as Senior Engineer at Contraves Zurich (working on a product assurance concept with training of middle management and project heads) and 5 years in Neuchâtel to create the Swiss Test Laboratory for LSI/VLSI, I had in 1985 the opportunity to publish by Springer-Verlag the habilitation thesis *On the Use of Stochastic Processes in Modeling Reliability Problems* and the 1st edition of the book *Qualität und Zuverlässigkeit Technischer Systeme*.

• Starting 1986, I was Professor for Reliability Engineering at the ETH Zurich up to my retirement (full Professor since 1992). Important at the ETH was an effective cooperation with large and medium industries in Europe to purchase large equipment and to support important research projects.

• In 1994 the 1st edition of the book *Reliability Engineering* and in 2017 the 8th and final edition of the book *Reliability Engineering* were published by Springer.

3. I.C.B.: The beginning of your activities in the reliability field goes thus back to your Ph.D. thesis?

A.B.: Yes, my first contact with reliability engineering goes back about 50 years with an expertise on a large air defense system for the Swiss army, delivered 1970 by Hughes. This was followed by a Ph.D. thesis (ETH 5375, 1974) dealing with a new generator for stochastic processes based on the concept of failure rate (*Math. & Comp. in Simul.*, 19(1977)), and the extension of the investigation of the 1 out of 2 redundancy to the case in which the involved stochastic process has just one regeneration state over 5 states (*IEEE Trans. Rel.*, 24(1975), pp. 336-340).

4. I.C.B.: How was it possible to realize the level of cooperation with industry that you have reached at your Chair for Reliability Engineering at the ETH Zurich?

A.B.: In fact, as described on pp. 659-74 of *Quality Engineering* 8(1996), a pool of more than 30 large and medium industries cooperated with my Chair for over 10 years with 20,000 EUR per year and industry to support projects and the purchase of high tech equipment (20 Engineers & Scientists of which 8 Ph.D. candidates and 6 million EUR equipment). This was possible also thanks about 15 years experience in industry, 4 of which in creating the Swiss Test Center for VLSIs circuits in Neuchâtel (an 8 million EUR project supported by the Swiss government 1979-83), and a favorable economical opportunity period.

5. I.C.B.: Creativity is thus necessary to reach high targets in any project or activity, what is your concrete opinion on this point?

A.B.: Creativity is generally defined as the capacity to create and invent with free fantasy, for engineer and scientists; it can also be expressed as capacity to give new, better solutions to known or emerging problems. Creativity can not be deployed on command; it can be stimulated by an internal conviction/confidence, a deep observation of and reflection on the nature around us, and often also a reaction to an adversity. In any case, a predisposition and a favorable environment are necessary to develop and support it. However, creativity can be deemed by demotivation, excessive depersonalization or excessive bureaucracy. Bureaucracy and the often related corruption are the worse sores that bother many states.

6. I.C.B.: How do you explain the success of your book *Reliability Engineering*, Springer, now at the 8th English edition, after 5 German editions, considered as a veritable "Reliability Bible" and for which a Chinese Translation will appear soon?

A.B.: Besides the more than 15 years experience in the industry, and a predisposition to be a self-taught man, my attitude to life was surely an important key for the success of my book. This is best expressed in the seven sentences given on the 1st page of my book in the last editions:

• The first sentence is from Louis Pasteur (about 1850) and says:

"La chance vient à l'esprit qui est prêt à la recevoir."

something like: "Opportunity comes to the intellect which is ready to receive it."

• The second sentence is from Louis De Broglie (about 1930) and says:

"Quand on aperçoit combien la somme de nos ignorances dépasse celle de nos connaissances, on se sent peu porté à conclure trop vite."

something like: "When one recognizes how much the sum of our ignorance exceeds that of our knowledge, one is less ready to draw rapid conclusions."

•The third sentence is from Francesco de Sanctis and says: "Prima di essere ingenieri voi siete uomini."

something like: "Before being engineers you are men."

• The following four sentences belong to me, namely:

"One has to learn to consider causes rather than symptoms of undesirable events and avoid hypocritical attitudes."

"Freedom is to be fulfilled while respecting others."

"It is time to remember that humankind needs nature, but nature does not need humankind."

"It is time to recognize the necessity to extend the Declaration on the Right of Peoples to Peace to a Universal Declaration of People's Rights, and to move so toward a world wide Confederation of Democratic Republics."

These seven sentences centered on generosity, modesty, ethics, responsibility, liberty, sustainability and people rights apply quite general to a wide class of situations and people, and it is to hope that the fourth, sixth and seventh sentences, in particular, will be considered by a growing number of humans, now, in front of the ecological problems we are faced and in front of the necessity to create a federal world wide confederation of democratic states in which freedom is primarily respect for the other. There are some few other suggestive sentences in my book, for example that saying "it would seem to be opportune to unify models and data, taking from each model the "good part" and putting them together for "better" models (strategy of wide applicability)". All these sentences, added to a great willingness and perseverance, express a life attitude which was surely important for the success of my book *Reliability Engineering*.

The historical development of my book during over 30 years, is resumed in the preface of the 8th edition (available also on my Homepage *www.birolini.ch*).

7. I.C.B.: You have a long cooperation with some Romanian scientists in the field, what is your opinion?

A.B.: This cooperation goes back 25 years, in particular with you, Professor Bacivarov; you was guest - as an Invited Professor - at my Chair for Reliability Engineering at the ETH Zurich, sometimes early in the '90s; I appreciate this cooperation as a good one since that time, even though it was mainly centered on the exchange of experiences and results, as on large projects. Based on the papers and books published by the Romanian specialists in the field and on the presentations done at the ***CCF*** conferences, I know that

there a long and good tradition in Romanian academia and research in quality and dependability field, and even one can speak now of a "Romanian school" in these domains.

8. I.C.B.: You was the special guest of several editions of the International Conferences on Quality and Dependability - ***CCF*** organized in Romania during the last decade. What is your general impression concerning these conferences?

A.B.: In my opinion, ***CCF*** is a good International Conference covering quality & RAMS (Reliability, Availability, Maintainability & Safety) engineering, assurance and management as well, with a particular emphasis to data & communication security problems; a good trend was also the growing attention to practically oriented dependability engineering aspects. Organization and support of these conferences, were almost perfect; however, to further improve the international character, English language should be preferred for all presentations and discussions.

Professors Alessandro Birolini and Ioan Bacivarov were the coordinators of the plenary session "Risk and IT Security" during CCF 2016

9. I.C.B.: You have somewhat followed the development of Dependability Engineering in Romania, what are your opinion and suggestions?

A.B.: As pointed out in your presentation at CCF2016, Romania, and you in particular, was actively and successfully involved in introducing RAMS Engineering in Academia and industry since the 70's; as everywhere on the world, the industry support is essential here, and it take time to reach acceptance and concrete results. Romania is on a good way in this direction.

10. I.C.B.: To the future, which should be in your opinion the future of reliability engineering, in research and development?

A.B.: In order also to support a sustainable development, a basic course on reliability engineering should belong to the curriculum of almost all engineering degrees (as stated 2003 in the preface to the 4th edition of my book). With respect to research, besides the reliability aspects in all technological development (lead-free soldering at assembly level and nano technology at devices level, just to give two examples), which must be solved together with specialists working in the corresponding fields, improvement in remote diagnostic and maintenance, as well as further research on modeling systems with hardware and software, distributed structures (e.g. networks), imperfect switching, incomplete coverage, common cause failures, elements with more than two states are necessary, also here just to give some important areas.

11. I.C.B.: What can you tell us about the importance of cybersecurity in the context of the new digital economy and how you can appreciate the Romanian initiatives in this area, as you have seen in the works of the ***CCF2016*** conference?

A.B.: Cybercrime is an extremely serious problem for modern communications systems, with possible large economic and social consequences. It must be considered making use of new, sophisticated appropriate hardware and/or software means. For this purpose, education and training in this field becomes very important, but performed in close cooperation between computer science and electrical/electronics departments at university level.

At the same time, it is of crucial importance for all the countries, professional organizations, and companies to consolidate a powerful "*cybersecurity culture*".

In this context, I must salute the initiative of a group of enthusiastic specialists in the field of cybersecurity from Romania, who set up the *Romanian Association for Information Security Assurance - RAISA*, five years ago.

One of the most important objectives of RAISA during these years was to build a "*cybersecurity culture*" in Romania, through workshops, training programs and particularly of the *International Journal of Information Security and Cybercrime - IJISC*.

I.C.B.: Thank you Sandro for this interview. At the anniversary of 77 years of an exemplary life and a long and fruitful scientific career, I wish you - in the name of the specialists in this domain - a long and fruitful life, with many achievements in the field to which you devoted yourself: the *reliability*.

Interview conducted by Ioan C. BACIVAROV
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