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# In Memoriam : Elart von Collan

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## Obituary

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On February 25, 2017, we lost the founder and longtime Editor-in-Chief of this journal, Prof. Dr. Elart von Collani. Taking care of the journal was only one among many of Elart's responsibilities. He was also an engineering educator, an author of scientific articles and books, a lecturer in Mathematics and Statistics at Würzburg University, a visiting professor at universities all over the world, a philosopher, a benevolent and noble man, and a true friend. On the following pages, I will express my personal account of Elart's character and of his scientific work.



Elart von Collani (1944–2017)

**Favored Topic: Modeling Uncertainty.** Elart von Collani's entire research revolved around the concept of uncertainty. In modeling uncertainty, he identified two sources of uncertainty: human ignorance with respect to the past and universal randomness with respect to the future. According to him, randomness is a characteristic property of any real-world process, because each process' repetition yields a different outcome. Thus, modeling randomness means modeling this variability, taking into account the limited knowledge or ignorance about the initial conditions. In commemoration of Jakob Bernoulli, von Collani named this mathematical model of uncertainty, describing the transition from past to future, *Bernoulli Space*. Utilizing the *Bernoulli Space*, he developed reliable and accurate stochastic prediction and measurement procedures for making decisions. In contrast to traditional scientific models, the *Bernoulli Space* does not require any additional assumptions or principles. This is due to abandoning the explanatory power in favor of descriptive accuracy of the model. More generally, Bernoulli Space is a rational alternative to the traditional scientific models that are built on the two questionable principles of determinism and reductionism. Elart von Collani called his new approach to science *Bernoulli Stochastics* because it follows Bernoulli's insight that an explanation of the Creation (universe) is impossible and, therefore, should not be attempted. According to von Collani, the main differences between *Bernoulli Stochastics* and traditional science are the following:

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- Traditional science is an attempt to explain the whole by looking at its parts (reductionism), while *Bernoulli Stochastics* is a holistic approach, aiming at deriving reliable and precise stochastic prediction procedures.
- Traditional science is essentially based on determinism and causality, aiming at discovering truths, while *Bernoulli Stochastics* admits the existence of randomness and the impossibility of detecting truths.
- Traditional science rests on theories being the result of a flash of genius, while *Bernoulli Stochastics* represents the outcome of a regular appraisal of experience and observation.

Elart von Collani found excellent applications of this approach, particularly in the construction of new rules of tolerance interval predictions. In the first part of [14], the fundamental concept of stochastics, the Bernoulli Space, is briefly introduced as an appropriate description of the real uncertainty. Next, two stochastic procedures are identified, concerning (i) the indeterminate future and (ii) the determinate, but unknown past. The second part of this paper is devoted to production processes. It is shown that traditional statistics process control (SPC) methods lost their significance within the modern production environment that is characterized by an ever increasing degree of automation and by objectives that differ considerably from those during the pre-computerized times. The larger degree of complexity of the new process environment and the more demanding goals require new advanced means for dealing with uncertainty. Examples are given about how stochastic methods comply with the needs of the modern production processes.

Professor von Collani found another application of *Bernoulli Stochastics* in studying the lifetime cost of wind turbines. In his words, "The predicted long-term loads for wind turbines determine turbine cost and reliability; and therefore, the definition of the maximum loads, which might realistically occur during the turbine's lifetime, are of considerable importance. The difficulty with predicting the extreme loads derives from the involved uncertainties. Uncertainty refers to the wind and materializes in variability in the sense that the wind speed and the load magnitude varying in time, even if the meteorological conditions do not change. Therefore, the problem is to describe the variability of the loads in a way that allows reliable, and at the same time accurate, predictions of the maximum loads that the turbines have to withstand. The predictions must have a specified reliability, as otherwise the inherent risks would be unknown, and they should be accurate, as otherwise the cost of manufacturing the turbines would become excessive." The investigations are published by LEXPOL (http://lexpol.cloud.pf/) and are based on results concerning stochastic handling of uncertainty, yielding sets of probability distributions for each individual wind bin. These sets cover the unknown true distribution instead of approximating it by a fitted distribution, as is the case in the conventional approaches. The coverage refers to uncertainty measured by entropy and some characteristic distributional properties. Thus, the stochastic models allow reliable and, with respect to the available knowledge, most accurate predictions. Based on the models for specified values of the mean wind speed and turbulence, prediction procedures for extreme loads are developed in the unconditional case as well as for a long period.

Elart has made all efforts to make his ideas widely accepted and popular. The novel approach, *Bernoulli Stochastics*, is presented in [16]. One big obstacle for introducing it seems to be the prevailing way of deterministic thinking as well as the technical mathematical language used by *Bernoulli Stochastics*. To overcome this, Zhai and von Collani in [17] developed a graphical presentation to support the understanding of *Bernoulli Stochastics* by visualization of uncertainty. Here is how they explain this in [17]: "More than 300 years ago Jakob Bernoulli made an attempt to initiate and to develop the Science of Prediction, which is in Latin Ars Conjectandi and in Greek Stochastike. The aim of Bernoulli's stochastics is not to discover 'truth', but to make reliable and accurate predictions as the basis for making appropriate decisions. Only recently, Jakob Bernoulli's plan of a Science of Prediction was resumed by Elart von Collani, who further developed it to a unified theory of uncertainty. In this paper, an effective online environment is presented and discussed for fostering the fundamental ideas of Bernoulli's stochastics and the techniques developed within this new scientific approach."

It is impossible to review all of Elart von Collani's works on modeling uncertainty. In the end, let me mention [18]. There, the authors evaluate the usability and learnability of the virtual classroom, *Stochastikon Magister*, a product of von Collani's company Stochastikon GmbH. The results show that more than 70% of teacher candidates who selected the *Magister* e-learning program to study *Bernoulli Stochastics* feel satisfied with both the *Magister* learning environment and the *Bernoulli Stochastics* teaching content. Most of the par-

ticipants had a positive attitude toward the e-learning systems as a replacement of classroom teaching for other areas of mathematics and natural science. The positive response in the questionnaire is consistent with other empirical evaluation of the *Stochastikon Magister*.

**History and Philosophy of Statistics.**  Elart von Collani devoted much of his time to the *history of stochastics*. Studies on the heritage of Jakob Bernoulli were one of his favored subjects. Without discussing in detail Elart's publications, I especially appreciate his critical point of view on the entire historical development of Statistical Science. In 2014, Elart was an invited speaker at our *Flint International Statistical Conference*. At the conference's official dinner, he presented the talk *Five Turning Points in the Historical Progress of Statistics – My Personal Vision*. In this speech, he addressed the question why statistics penetrates almost all branches of science and all areas of human endeavor. He also discussed why statistics has been misunderstood, misused, and abused to a frightening extent and why students in colleges and universities often dislike it. Article [10] addresses the historical development of statistics, identifying the most important turning points that led to its present prestigious state. Other challenging questions discussed are "What went wrong with statistics?" and "What to do next?" Readers can find many hidden and unknown historical facts that open our eyes to the developments statistics went through and what we can gain from this knowledge. The paper is also an autobiographical analysis of von Collani's own research and his development as a researcher and educator in this field.

Here are a few excerpts from this remarkable article. Of course, Jakob Bernoulli comes first: "Not approving Bernoulli's quantification of randomness and not continuing his development of stochastics represents *the first and decisive turning point* in the development of a science dealing with uncertainty. It meant adopting the shell but not the content. Randomness was again reduced to gambling, and probability to a ratio of cases." Elart then reviews the work of a number of authors working on problems related to both gambling and political life.

"The introduction of the new name statistics represents *the second turning point*, as it does not stand for any goal or subject of investigation. Statistics may stand for everything dealing with data. The crux is that any science deals with numbers and hence could, in some sense, be looked upon as part of statistics." Here, Elart notices the importance of the normal distribution, and the establishment of national statistical associations in numerous countries.

The *third turning point* is associated with the names of Pierre-Simon Laplace (1749–1827) and Lambert Adolphe Jacques Quetelet (1796–1874). Other contributors are also discussed; however, the focus is on Quetelet who "denied the existence of randomness and insisted in determinism and causality. In order to be able to copy the methods of physics, not the observed variability was the target, but, following physical practice, the mean that showed only relatively little variability. He also established the normal distribution as the standard model for the always existing variability, making any special research with respect to variability unnecessary."

Kolmogorov's "Foundation of the Theory of Probability" constitutes *the fourth turning point*. "It finalized the development of probability theory as a special branch of mathematics and by this cut the already loose relation between the theory of probability and reality with the following consequences:
- Models and procedures are derived since then according to mathematical criteria (for instance mathematical feasibility or as limits) without appropriate consideration of reality and the need of applications.
- The mathematization requires explicitly an interpretation of the term probability when applied, which led to many inconsistent interpretations.
- The ambiguity of statistics and the term probability led to fragmentation of statistics in many separate branches according to the different fields of application and their needs."

The *fifth turning point*, according to Elart, is still going on nowadays. "In philosophy, in science and in statistics the term randomness has been discussed for many centuries. One of the reasons why the discussion does not end is the fact that people still believe in determinism and strict causality and deny anything like randomness. None the less, randomness is considered in some special fields of science (even in physics!), but with many different interpretations which makes it impossible to clearly specify its meaning."

**Secondary Fields of Research.** Let me mention my joint work with Elart in analytical research. It began in 1990, during my first visit to Würzburg University. We became obsessed with various analytical characterizations of probability distributions. For instance, it is known that if a random variable $X$ satisfies the condition

$$P\{X \geq uv \mid X \geq v\} = P\{X \geq u\} \quad \text{for any } u, v > 0,$$

then $X$ possesses the multiplicative lack-of-memory property. This equation characterizes the uniform, or Pareto distribution, depending on whether $u$ and $v$ are less than 1, or more than 1. We looked at what happens when the above property is satisfied for a fixed value of $v = a$, say, and for any $u$. As a result of these investigations, we obtained a new class of probability distributions that we named *contorted uniform* and *contorted Pareto distributions*. More details can be found in [2].

Certainly, more examples of joint works with von Collani could be discussed by Monica Dumitrescu (Romania), John Sheil (Ireland), Olgierd Hrynewicz (Poland), Frank Beichelt (South Africa), S. P. Mukherjee (India), Rainer Göb (Germany), Nikolai Kolev (Brazil), Waltraud Kahle (Germany), his PhD students, and many other collaborators from all over the world.

**Elart von Collani, German Engineering Educator.** Elart published a number of books on statistics for engineers. For example, handbook [13] is directed at scientists and engineers who need to estimate and test hypotheses about the probability of an event. According to the authors, "The purpose of the book is twofold: it aims at providing practitioners with refined and easy-to-use techniques as well as initiating a new field of research in theoretical statistics. The book contains completely new interval and point estimators as well as test procedures that are superior to the traditional ones. This is especially true in the case of small and medium-sized samples, which are characteristic for many fields of application. The procedures are derived for fixed and bounded parameter ranges, thus allowing the selection of a method tailored to a given situation. Thus, according to the size of the proportion or probability of interest different estimators should be used, similar to the case of measuring length, where the measurement method depends heavily on the size of the length to be measured. The approach yields more precise estimators and more powerful tests. It may also be applied to other estimation or test problems." I have nothing to add to this. Elart is being Elart here! His approach, based on Jakob Bernoulli's ideas, deserves dissemination and true implementation in life. The handbook is very well-structured and can be used as a textbook in any engineering practice and training.

Noteworthy is also [4, Chapter 15], where von Collani introduces different approximations and algorithmic solutions for a compound system, studies their effectiveness, and gives numerous examples of how they work in a variety of networks. The exposition is an excellent example of German accuracy and how an engineer should be educated.

Lastly, a month before he died, I invited Elart to take part in the 2019 *International Conference at Kettering University*, marking the 100th anniversary of Kettering University. Elart answered, "Let me wholeheartedly thank you for the invitation for the 100-year anniversary of Kettering in 2019 and I certainly accept your invitation. I hope that I will be able to come, but this would give me a further argument to fight the disease. In fact, I have worked on the field of statistics in engineering education and published some articles about it. Please let me know the details as soon as they are available." Elart never gave up, and we should follow his example!

**Work, Scholarship, and Citizenship.** Elart von Collani was a workaholic. I noticed this during my first visit at the Würzburg University in 1990. His colleagues, Herbert Vogt and Herbert Basler, also pointed this out to me more than once. Elart and I worked in the attic part of the math department's building until late in the evening. Elart was working on a variety of things: on the editorials of the journal *Economic Quality Control* (EQC), on his own research interests, on lectures to be prepared for the following day, on communications with other researchers, on our joint project, etc. After work, we would walk to his home for a glass of wine with his lovely wife Claudia.

One of Elart's most important legacies, in my opinion, is his work for the EQC journal, which he founded in 1984 and led for about 30 years. He had to respond to numerous submissions of manuscripts, to find appropriate referees for everyone, to prepare timely information on almost every significant event in the world in the field of statistics, quality, reliability, etc. Most of this he did by himself and I was impressed by his

working morale. Every single issue of EQC was provided with an editorial note, information, or comments. This is a full-time job, and Elart accomplished all that *en passant* and with great inspiration that he deserves high admiration for!

Elart responded positively to most of the significant world events in his areas of research interests. I first met him in 1988 at an *International Conference* in Varna, Bulgaria. He participated in a special session on current issues in quality control. I subsequently visited Würzburg thrice, for joint research and a workshop. In 1999, Elart and I organized a quality control session in the *Detroit Renaissance Center*. He brought several German participants with him. A few years later, I had one more presentation in his Würzburg seminar, and became an active associated editor of EQC. In 2014, Elart was an invited speaker at the *Flint International Statistical Conference*. However, it is not our personal relationship that I want to point out here. I am talking about his participation in many scientific activities in Japan, India, Brazil, Greece, Bulgaria, Poland, Germany, the Netherlands, Russia, Rumania, Spain, Austria – I cannot list all. This was a scholarship to envy. Everyone who met him had wonderful memories of him. About four years ago, my nephew Ivo Naev (a nuclear power plant safety engineer) met Elart at a *Vienna International Meeting*, and kept telling me what a fine person and knowledgeable expert Elart is.

I should not forget mentioning the nine PhD students supervised by Elart at the Würzburg University. In chronological order they are: Rainer Göb (1991), Christoph Weigand (1991), Michael Sachs (1993), Peter Frahm (1994), Herbert Schneidemann (1996), Klaus Dräger (1998), Gudrun Kiesmüller (1998), Andreas Binder (2008), Xiaomin Zhai (2011). Everybody would be proud of such heritage!

In the citizenship arena, I would like to point out the following activities:
- Elart von Collani founded and headed his company STOCHASTIKON GmbH that specializes in developing software and problem solutions under uncertainty.
- He was the coordinator of an international EC-project in the framework of COPERNIKUS (CP93-12074).
- He was the leader of a CEN (European Committee for Standardization) working group (WG1) for developing a standard for controlling postal services.
- He was co-founder and Chairman of Neues Siebold-Forum zu Würzburg e.V.
- He was co-founder and Chairman the Society of Reliability, Quality and Safety.
- He worked among others as a consultant of the German Regulatory Body.
- He worked for the DKFZ Heidelberg/Huntsman Cancer Institute of the University of Utah.
- He worked for TÜV Nord.
- He was appointed as an expert to the High Court of Justice in London.

All these commitments speak volumes about Elart's professional qualifications.

**Education, Career and Membership.** Elart von Collani graduated from the University of Würzburg in 1972. He had two doctoral degrees: *Doctor rerum naturalium* (Doctor in Sciences), University of Würzburg, Germany, 1978. Dissertation: *Kostenoptimale Prüfpläne für die laufende Kontrolle eines normalverteilten Merkmals*. Advisor: Werner Uhlmann. Elart earned his *Doctor rerum naturalium habilitatus* from the University of Würzburg in 1983. The title of Elart's habilitation [3] is: *Das Minimax-Regret-Prinzip für Stichprobenpläne beim Ziehen ohne Zurücklegen*. From 1989 to 1997, he was a professor of stochastics with the Faculty of Mathematics and Statistics and thereafter with the Faculty of Economics at the University of Würzburg. He was a guest docent at universities in Japan, Sweden, Hungary, Germany and Brazil. Elart was also a member of prestigious national and international organizations, such as Neues Siebold-Forum zu Würzburg e. V., the Society of Reliability, Quality and Safety, and the International Statistical Institute.

**Personal Biography.** Elart von Collani was born on April 1, 1944 in Litzmannstadt (now Łódź), Poland. He was the youngest of four children of Thassilo Hugo and Dr. Adelheid von Collani. He married Claudia Elisabeth Radina on December 21, 1974. They have three children: Tora Belinda, Sina Larissa, and Arno Roderich.

My dear friend Elart, I will always keep you in my heart!

**Discloser.** Everything written above is expressing the sole opinion of the author. It does not engage by any means neither De Gruyter, nor Kettering University or its Mathematics department.

# References

[1] E. del Castillo, R. Göb and E. von Collani, A methodological approach to the integration of SPC and EPC in discrete manufacturing processes, in: *Statistical Process Monitoring and Optimization*, M. Decker, New York (1999), 77–105.

[2] B. Dimitrov and E. von Collani, Contorted uniform and pareto distributions, *Statist. Probab. Lett.* **23** (1995), no. 2, 157–164.

[3] E. von Collani, *Optimale Wareneingangskontrolle. Das Minimax-Regret-Prinzip für Stichprobenpläne beim Ziehen ohne Zurücklegen*, Teubner, Stuttgart, 1984.

[4] E. von Collani, A simple algorithm for calculating approximately the reliability of almost arbitrary large networks, in: *Advances in Stochastic Models for Reliability, Quality and Safety*, Birkhäuser, Boston (1998), 213–233.

[5] E. von Collani, The Neyman theory – A scientific measurement theory (in Russian), in: *Basic Problems of Precision Theory*, Nauka, St. Petersburg (1999), 77–105.

[6] E. von Collani (Ed.), *Defining the Science of Stochastics*, Heldermann Verlag, Lemgo, 2004.

[7] E. von Collani, History, state of the art and future of stochastics, in: *History of Mathematical Sciences*, Hindustan Book Agency, New Delhi (2004), 171–194.

[8] E. von Collani, Jakob Bernoulli deciphered, *Bernoulli News* **13** (2006), no. 2.

[9] E. von Collani, Defining and modeling uncertainty, *J. Uncertain Systems* **2** (2008), 202–2011.

[10] E. von Collani, Five turning points in the historical progress of statistics – My personal vision, *Serdica J. Comput.* **8** (2013), no. 3, 199–226.

[11] E. von Collani, History of quality control, the role of ISO standards and the terminology in statistics, *IAPQR Trans.* **1** (2013), 197–216.

[12] E. von Collani and K. Baur, *Was zum Teufel ist Qualität?*, Heldermann Verlag, Lemgo, 2007.

[13] E. von Collani and K. Dräger, *Binomial Distribution Handbook for Applied Scientists and Engineers*, Birkhäuser, Boston, 2001. Reprinted in 2012 by Springer, New York.

[14] E. von Collani and M. Dumitrescu, Stochastic methods for production processes, *Econom. Qual. Control* **19** (2004), no. 1, 61–82.

[15] A. Y. Yakovlev, E. von Collani, M. Mayer-Proschel and M. Nobel, Stochastic formulations of a clock model for temporally regulated generation of oligodendrocytes in vitro, *Math. Comp. Modelling* **32** (2000), 125–137.

[16] X. Zhai and E. von Collani, A graphical tool for visualizing Bernoulli stochastics, *iJET* **4** (2009), no. 3, 44–50.

[17] X. Zhai and E. von Collani, Strategies for teaching a novel approach to handling uncertainty scientifically via internet, *iJET* **4** (2009), no. 2, 52–57.

[18] X. Zhai and E. von Collani, Evaluate Stochastikon Magister by questionnaire, *iJET* **6** (2011), no. 1, 44–52.