A Brief Story of The Partnership

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"Remember, remember the fifth of November". It was November 5th, when I have exchanged with Maciej last mails before my first research visit to Newcastle University (several months earlier I was attending Petri Nets conference in Newcastle). Two days later I was already in Northumbria and met Maciej in Claremont Tower. After only a few meetings we establish the common language and get to know each other's interests. The outcome was almost immediate and during three weeks of my first visit in Newcastle we obtained advanced draft of our first common paper – "Hasse diagrams of combined traces" – together with several ideas and plans for future. The paper was ready in January, submitted and accepted for ACSD'12.

The submission process overlapped with our second research meeting, when Maciej came to Toruń as Visiting Professor. We had a lot of inspiring conversations, very intensive weeks of seminars when Maciej and whole FoLCo group (including Kamila Barylska, Marcin Piątkowski, Edward Ochmański† and me) presented their recent results. In the meantime, I was working on my second paper related to combined traces. Thanks to priceless comments done by Maciej, the paper "Algebraic Structure of Combined Traces" was good enough to be accepted for CONCUR'12. For me this was something incredible – new research topic, new friend, and two papers accepted for quite recognizable conferences in less than four months. But the magic only begins...

After the conference period (namely summer) I got back to Newcastle. This time for much longer, as I obtained a half-year postdoc scholarship and I became officially a visiting researcher in Newcastle University. The winter was fantastic. I started with the review of very early draft of the book (also known as THE BOOK) that Maciej has been writing with Jetty Kleijn and Ryszard Janicki. It turned out that my doubts related to the generalisation of combined traces were reasonable. The redefinition of this model became one of the main challenges for the postdoc. And we succeeded! The definition of generalized traces was simplified by introducing "sequentialization" relation and founding on their base traces equivalence. The equations present in the definition became simple and elegant. Everything indicated that we got it!

Moreover, in order to obtain a generalization, the set of axioms sufficient for structures underlying combined traces was firstly extended by "indivisible steps synchronization". That directly solved the counterexamples related to my earlier doubts. It remained to check whether the obtained model is indeed sound.

The attempt to prove the suitable version of Szpilrajn theorem (which narrowly bonds sets of equivalent observations and the structure of their invariants) revealed one more missing axiom – due to cross structure of the property and our roots related to Toruń called by us "teutonic axiom". And we hit the spot once more! When everything is defined properly, all the elegant properties and their proofs are only the matter of time. As a result, we solved the problem that was remained open in an old paper written by Maciej and Ryszard – "Structure of concurrency". Moreover, I have joined the editorial board of THE BOOK and wrote with Maciej, Jetty i Ryszard several papers discussing various issues related to the newly defined objects. We have related inhibitor bounded Petri nets with mutexes to step traces and their invariant structures, provided many useful analysis techniques and tools or classify step alphabets with some applications for their synthesis, to give examples not exhausting the topic.

The long and fruitful period of my collaboration with Maciej during this time was not limited to the trace theory. It turned out that together with his wife Marta Pietkiewicz-Koutny, he was involved in a project that aim to propose a useful mathematical framework for globally asynchronous, locally synchronous systems. Taking the opportunity, I jumped into this project on the stage when the first algorithm was already written. Together with Maciej and Marta, we refined the mathematical part of the algorithm and extend underlying concurrency taxonomy. This line of research systematized local view to persistence and formally introduced its second facet – called nonviolence. After some incremental corrections and extensions made during our meetings in Newcastle and Toruń, the final taxonomy was presented in 2017 in the form of paper "An extension of the taxonomy of persistent and nonviolent steps" published in Information Sciences with "Gold Open Access".

In 2016, together with New Year's greetings, Maciej surprised me asking, whether I am interested in reversible computations. The reason was his opportunity to visit Toruń and discuss with me their paradigms in the view of Petri nets. He correctly predicted that there is no need to repeat such propositions twice to me. And in February we met for a two-week Short-Term Scientific Mission in Toruń. Like usually in the collaboration with Maciej, the results came out of the blue. We proposed the framework and together with the rest of FoLCo team prepared a paper for RC'16. This way we also have some material to present in the meeting of COST Action that funded Maciej's scientific mission already in March 2016. We managed to prove that even the question whether adding a strict reverse to a single transition in Petri net changes its behaviour (enlarges the set of reachable markings) is undecidable. After some time (and supported later by Evgeny Erofeev) we conducted some tests getting opposite result in the case of bounded nets. The decidability of considered question was not surprising, but it appears that after delicate relaxing of the aim (namely by allowing to split reverses) we are always able to revert whole system.

The topic of reversible computations in view of Petri nets became our main common research direction for the following two years. Together with David de Frutos Escrig we focused on possibility of reversing bounded systems without

splitting (with the paper "An efficient characterization of Petri net solvable binary words" presented in ATPN'18) as well as reversing steps and multisteps, and we had three common Short Term Scientific Missions (two in Newcastle and one in Madrid), the fourth STSM is planned in Toruń. This research direction proposed by Maciej opened up a possibility to met and cooperate with Ivan Lanese (Bolonia) and Anna Philippou (Nicosia).

Finally, we reached another topic of our common interests – Reaction Systems. During the STSM in Madrid in 2017 we had an opportunity to utilize shared evenings and conduct discussions in casual atmosphere. We made some informal proofs related to previous common research (like minimality of our axiom system for invariant order structures) and started the discussion on Reaction Systems. It materialized as a common paper (written together with Grzegorz Rozenberg and Jetty Kleijn) – "Reaction Systems, Transition Systems, and Equivalences". Maciej presented its insights during the First International Workshop on Reaction Systems and we plan to lift our collaboration in this field to more formalized level.

The invitation to write such informal paper to celebrate Maciej's 60th birthday is for me the priceless opportunity to summarise and appreciate all the income that I got from our collaboration. How his patience and incredible ability to match right people with right challenges allowed me to develop and became an independent researcher in the field of Concurrency Theory. I am extremely thankful for all the time that he devoted to our conversations. I am finding our meetings similar to fairy tales – there is a story, some adversities and difficulties (which only underlines that the obtained results are far from trivial), but finally, sometimes with a little help from newly met friends, there is always happy ending! During the past seven years of collaboration we have written a lot of common papers (seventeen of them are indexed by DBLP). I am really glad that the November 2011 took place and I am looking for more such "Novembers" in the future!