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The Good ICT Design and Implementation Practices: Metallurgical and Radio-Astronomic Case Studies

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Abstract: This article is a herald of our Book 3 devoted to good ICT (Information and Communication Technology) design implementation practices gained during design and development of the Polish pioneering Computer Control Systems destined for the Steel-Bar Mill of a Warsaw Metallurgical Plant in Warsaw and for the Michelson Interferometer of the Nicolas Copernicus University in Torun. This article describes the basic premises valid for the Steel-Bar Mill system and the position assumed by the small 2-person design team to prove that such complex Computer Control Systems may be designed by local teams using home computer hardware and software systems. The description of Odra 1204 hardware and software available for the project is roughly mentioned together with the presentation of the performance evaluation system developed and run for the Steel-Bar Mill commissioning case and general as well as detailed conclusions. The final phase was mentioned and general conclusions were drawn. The ethical and HB assessment were developed and validated. Similar steps were mentioned and/or described for the Michelson Interferometer (Radio-Astronomic Dish Set planned for the Nicolas Copernicus University in Torun).

Keywords: Steel-bar-mill, Computer Control System (CCS), Material Flow Control, Heating Ovens, Michelson Interferometer, Radio-Astronomic Dish, Super-Synthesis of Aperture, Movable Dishes

1. Introduction

After the end of the World War II, Poland was given as the best gift to the Soviet Union and J. Stalin, personally (J. Stalin, 1945, Private Message). The Country was betrayed by the Allies and given as the spoils of the War II to J. Stalin and the Soviet Union though the Country (Poland) suffered most from this deceitful and murderous system forcing Polish people to slave work in Siberian mines (J. Wojciechowski†, 1960, Private message). And Polish people fought most and longest against Communism (so called cursed soldiers even long after the end of the World War II). Therefore, the verdict of CoCom that included Poland in the Communist states resulted in a fury in this Country: a fury that often happened in this and resulted in a highly disciplined and courageous movement towards regaining of the Country liberty.

This article concerns ICT problems and it should be shown that this fury happened in the computer industry, also. Indeed, when the first American computer, Eniac, was assembled, many people of the country hoped that computer systems, Computer Control Systems (CCS), in particular, would accelerate the technological progress and improve the living conditions in the Country destroyed very severely during the World War II. When the people of the Country learned that they are treated as Communist and they could not buy computers for their own money, they answered to the Western politicians: you can put your computers where you wish; we will develop our own ones, better than yours, and they did it actually. (A. J. Kowalski† (the Coordinator of the next CCS for the Polish Power Industry Regional Power Dispatching Centers/Boards, J. B. Lewoc (the Author of this article), W. Wojsznis (the Consultant for CCS of this article, 1976, Private message).

2. First Polish CCS (Material Flow Control System in a Steel-Bar Mill)

2.1. Introductory Information

The most interest of the Polish Computer (called at the very beginning of the Computer Era the Computing Machines) were the CCS due to the deep hopes that the were capable of accelerating the technological progress and, consequently, improving the living level in the Country. However, the first computer manufacturer (Elwro) was charged not only with embargoes for final computers but also on electronic and computer components and Elwro could design and develop small computers of serial structure only, not-useful for industrial control application. However, in early Nineteen Sixties, due to a strong action done by the big manufacturers of electronic and ICT components against CoCom embargoes since the manufacturers could not export the components to the Eastern Europe Countries and suffered high financial losses. Elwro could buy legally some higher supplies of transistors and ferromagnetic components for internal computer memories and could design and develop a quite modern computer Odra 1204 of the parallel structure, multi-programmed, of full core memory and multi-programmed control. The integrated circuits were not available for Elwro I engineers but they possessed a nice experience in making very reliable systems basing on even germanium transistors (of operating live exceeding 20 years).

2.2. The First Polish CCS Design

At that time (late Nineteen Sixties), the heavy industry was considered the most important for the development of the Country (in particular, the Black Metallurgy) and this domain was chosen for design and development of the first Polish CCS project (1, Book 3). The metallurgical plant chosen was a Noble Steel Mill processing plenty of short production lots and needing computer control and coordination of production.

The basing functional project was developed by an experienced electrical engineer of the Metallurgical Design Agency "Biprohut". The CCS project was developed by Willy Wojsznis, a young computer engineer who selected even a younger ICT engineer (Jozef Bohdan Lewoc) to design and develop the CCS ([1], Book 3).

The habit of selection the youngest and, consequently, the least experienced engineers to design and develop the projects most difficult to be designed was a popular one during the pioneering ICT times in the Country. It was due to the WPR (Who has got Power is Right) (Communist) System in the Country which spoiled many experienced engineers teaching them a false idea that nothing could be done in this Country. Young engineers could not learn the false idea and work duly hard, indeed, to solve even, theoretically, unsolvable tasks.

2.2.1. CCS Commissioning in the Field

A popular WPR approach was to send inoperable systems (CCS or other ones) to their operating sites. This was treated as a proof that the project managers tried their best to operate and implement the systems. In fact, it was some advertising for them and starting up and commissioning of the system in the field was much, much difficult than in the Manufacturer's System Test Centre.

This case was valid for the CCS also, where the software for the ICT devices were not debugged at all before the CCS was send to the Steel-Bar Mill. The two Commissioning Engineers had to do their best to debug the CCS software as soon as possible and had no chance for presentation of the CCS to the Mill Staff. The Staff got distrustful against the Commissioning Brigade. Most of the Staff were post-prisoners of prisoning habits and one of them, even, attacked a Commissioning Brigade member with an axe. However, the member was an experienced Commissioner and defended himself successfully with a crowbar.

Fortunately, after a year instead of some month or two in the Manufacturer's Test Centre, the CCS Designers managed to start up the CCS and organize a trial run for the Mill Staff. The Design Engineers visited all operators' bridges and explained the operators what the CCS should provide for them.

And a miracle happened: from this instant on, the Mill Staff became apt to attack the CCS adversaries and not the CCS Commissioners.

2.2.2. Further CCS Expanding and Commissioning

The main problem with performance of the CCS trial run was the adverse position of the Automation Group of the Warsaw Metallurgical Plant Automation against learning the CCS and being responsible for the system operation. The Steel-Bar Bill Staff claimed: Dear Engineers. We believe you that you had done something useful for us but what would happen when you had to leave. And, after each Trial Run, they prepared a collection of modifications that should be implemented in order that CCS would be really useful for the Steel-Bar Mill. And the CCS Designers did the modifications waiting for the true Trial Run. At the end, they declared that the next Trial Run will be the last one in the Steel-Bar Mill.

2.2.3. Final Trial Run

The Final Trial Run of the CCS was adequately prepared by the two Designers. They remembers that the CCS was the first application of computer control systems in the Country and that the People and the Managerial spheres of Poland were looking for a proof that such complex CCS might be successfully designed and developed by local design teams and realized with home hardware and software. The detailed proves are described in [1] and the references are given in this article Reference List.

Considering that the CCS was the first (not only in the Country) pioneering/emerging/novel real-time ICT application, J. B. Lewoc prepared a survey of well known (in Ninety Seventies (and later years) [5-21]) of the queuing assumptions and methods. Unfortunately, all of them proved to be based on so called “ceiling defined” (inappropriate) assumptions that could not lead to correct evaluations of the CCS or similar realistic systems.

Lewoc J. B (1984) describes the critical evaluation of IBM /360 and /370 systems basing on the results of the UC Computer Laboratory System Phoenix [22].

Lewoc J. B (2005) presents a critical evaluation of Technology Transfer and Change in ICT development [23].

Lewoc J. B. *et al* (2010b) defines an Approximate Actual Network Performance Evaluation Method [24].

Lewoc J. B. *et al* (2010a) — A Network Modeling Technique [25].

Lewoc J. B. *et al* (2010b) — Performance of an actual network [26].

Lewoc J. B. (2012) - Some Social impacts of ICT [27].

Lewoc J. B. *et al* — Methods of struggling [28].

Lewoc J. B. *et al* (Eds.) — ICT (2020) - Performance and Robustness Investigation [29].

Investigation of Network Loops [30].

Technical Reports of the Phoenix System [31].

3. Final Phase of the CCS

3.1. The Final Trial Run

During the Final Run, Bogdan was controlling operation of CCS hardware and software while Willi attended the Trial Run Guests: the Steel-Bar Mill Head on Duty, the Automation Director and Automation Service Department Head. Bogdan found a software failure and called Willy to help him in debugging the failure via the loud-speaking system. An operator answered that all the guests went to the Dispatcher’s building. Bogdan went running to the Control building and found that the Head of the Automation Service Department tried to explain the auditors that the cables in the Control Building were not laid in accordance with Fire Safety Rules. The Automation Managers tried to break the Trial Run though it were not the Designers who were responsible for the Control Building cabling, but the Metallurgical Plant Design Agency.

For a several seconds, Bogdan could not hear nor see anything, until he heard his own voice shouting at the Automation Director: You may not stand at the System and … nonsenses. You may pay our dues or not, but nobody authorized you to stop the technological progress. Bogdan shouted many dirty words at the Automation Director till the Mill Head on Duty approached him and said: Please, Engineer, stop be nervous; I know that you are right, but, please, stop be nervous. And he accompanied the Engineer to the Control Building door.

The Head of the Mill on duty recognized that Bogdan was right and it was all: the Automation Managers could not interrupt the Trial Run and it was completed without later problems. However the Metallurgical Plant Mangers did not want to recognize that the Trial Run had been PASSED and sent their case to an Arbitration Commission.

3.2. The Final Trial Run Repercussions

When Bogdan learned that the Arbitration Commission is to define the guilty party for the CCS, he could not have any doubts about the possible verdict: the CCS Manufacturer would be recognized guilty. The Arbitration Commission should present verdicts not contradictory with the opinions of the General Secretariat of the Polish United Workers’ Party and it was a public secret that the complete Metallurgical Plant was established in Warsaw in order that the Capital City of the Country was strengthened with the highly industrialized working class. The Metallurgical Plant survived and, even, it was successful and, from that instant, it became an apple in the eyes of the Polish Communist Party.

Instead of the appearances, the Arbitration Commission accused the Metallurgical of trying to hinder the technological progress in the Country and sentenced that the CCS Trial Run results should be recognized as the final system results and the project assumptions should be considered met. And the Metallurgical Plant paid all their debts to the CCS Manufacturer.

The Computer Manufacturer made a significant manufacturing error: no Odra 1204 computer project was initialized though there were some plans to reconstruct Odra 1204 into a silicon integrated circuit computer of 16-bit word length. Therefore, the Polish CCS users had to wait a dozen or so years till the new Odra 1325 computer was designed and developed for the industrial control applications.

4. Michelson Interferometer

4.1. Introductory Information

There were very interesting plans to celebrate the 500-th anniversary of Nicolas Copernicus birth. The group of optical astronomers planned and initiated the construction of a big optical astronomic telescope which was to be bigger of optical telescopes of that time. On the other hand, the radio-astronomers of the Nicolas Copernicus University in Torun (Poland), who had very friendly scientific relation with the Cambridge University (Cavendish Laboratory) wished to celebrate the Anniversary of Copernicus birth with a modern radio-astronomic system of movable dishes.

Bogdan has worked out a nice professional and private human opinion and was granted his very first CCS project (The Radio-Astronomic Dish Control and Data Processing System (The Michelson Interferometer)). The initial actions of this projects are discussed hereinafter.

4.2. The Michelson Interferometer Initial Actions

In the Cavendish Laboratory, University of Cambridge, there was successfully developed and operated, a Radio-Astronomy System making use of so called Aperture Super-Synthesis [34] so that a much higher resolution was achieved when investigating sky signals at a much less price of the radio-astronomic equipment. The key idea was that much smaller dishes (of 25 m diameter in this case study) were movable on tracks and, due to the Super-Synthesis calculations, the resolution of the results was the same as that of a single radio-astronomic system of the diameter equal to that covered by the movable dishes.

The main creator of the UC Radio-Astronomic Observatory was Sir Martin Ryle† (Holder of a Distinguished British Order) [33] and, several years later, of the Nobel Prize [34]. Sir Martin was in friendly relations with the Polish Radio-Astronomy Pioneer, S. Gorgolewski† [35], did know him and believed in him, and when it was proposed to install a Michelson Interferometer in Poland (detailed location was planned in the Torun University Observatory in Piwnice), he did a lot for the application was successful (ref. [36] though much later).

Sir Martin was positively biased not only by his friendly relations with prof. S. Gorgolewski and other Polish Radio-Astronomers, but also by the fact that various observations could be taken from various points of the earth and construction of good and rather not expensive observatories should be supported by the whole radio-astronomy environment.

4.3. The Polish Design Team Training

The Polish design team training began from introducing of the mechanical and electrical staff into the interferometer problems (stationary and movable dishes, control and reception buildings). All lessons were given in a weekly period for several student groups.

The main computer group consisted of two experienced computer engineers: a software expert of the Polish Institute of Computing Machines (IMM) and a hardware expert of the of the Industrial Institute of Automation and Measurements (PIAP), Bogdan (the Radio-Astronomic Instrument Designer) and his Automation System Head and Prof. S. Gorgolewski. The Trainer was Sir Martin Ryle.

A lot of training was devoted to the general approach to complex research and practitioner projects divided into “by thinking” and “by managing” ones. The first one, favorable in the Cavendish Laboratory depended in provision of a very small financial support for young researchers/practitioners at the beginning and increasing the support to the researchers that could solve bigger and bigger problems with use of the limited support. Examples: The protein code discoverer team, the Radio-Astronomy Observation of the Cambridge University.

The “by managing” included many unsuccessful projects:

1) Jumbo jets that decreased the plane throughput instead of increasing it (due to much higher inter-plane times);
2) Jodrell Bank Observatory: Big money and low resolution;
3) Reconstruction of the Cavendish Laboratory Building in order to provide the scientific significance of the Laboratory.

The “by thinking” approach resulted in the biggest success of the Cavendish Laboratory: At that time (the Nineteen seventies, the Laboratory could boast with the highest number of Nobel Prizes of all laboratories of the world.

The lesson of the Radio-Astronomy proper (in particular, the Aperture Super-Synthesis followed. The Trainer, Sir Martin, tried to educate and upgrade the Designers of the Country so that they were capable of designing and developing the Michelson Interferometer in their Country.

4.4. The Polish ICT Design Team Projects

The Polish Radio-Astronomers governed by S. Gorgolewski organized a contest for the design of the Nicolas Copernicus University of Torun Radio-Astronomic Center in Piwnice. A contest was a simple joke: two the most experienced men in hardware and software, supported by the Country biggest ICT software and hardware Institutes, supported by the full staff of the Institutes, where it was needed, and a child, only, developing the first project lead by him and supported by a designer assistant and a technical drawer.

In addition, the Bogdan’s competitors were sure that they would win the contest: their Institutes had at their disposal the functional and operating documentation of the new Orion (Hungarian) Industrial Control Computer being developed for CCS applications in ComeCon countries. Bogdan did not possess such information. But he had something much more valuable: a few years of experience in designing and commissioning CCS. And he, together with the two girls, developed the Polish Michelson Interferometer project.

Due to his detailed experience in the Odra 1204 computer hardware and software, he was capable of designing process-control interfaces similar to those designed and developed for the Warsaw Steel-Bar Mill or designed from scratch by him and his small team.

The detailed knowledge of the Odra 1204 computer made it possible for Bogdan to design multiple pre-emptive resume priority system needed for sequencing various Radio-Astronomic tasks.

NB. The standard industrial interface computers applied in the Radio-Astronomy (in Great Britain or Netherlands) featured with the internal ferromagnetic core cycle of 1 μs. However, due to the CoCom (2) embargoes imparted on the ferromagnetic cores, Elwro Engineers could afford for the 1.6 μs cycle, only. Therefore, Bogdan and his Team enlarged their work range intensively, and designed and developed an event-driven simulator for investigation of the Michelson Interferometer performance. The investigations proved that the Odra 1204 would be satisfactory for the application discussed in this article.

The Hungarian industrial control computer did not help the Bogdan’s competitors to win the contest. The work done by him and his Team was very much appreciated, needed for the project and difficult. And, unexpectedly, the two biggest Polish Institutes (IMM and PIAP) lost and Bogdan with his small Team and the minimum possible support of his Manufacturer won the contest.

4.5. Post-Contest Events

The Michelson Interferometer project in the Country finished in a rather unexpected way:

The optical radio-astronomers holding professor titles convinced the Import-Export Agency involved in preparation of the Nicolas Copernicus Birth Anniversary that the contract with the prospective manufacturer of the big optical telescope (Carl Zeiss Jena, DDR) should be signed. The Agency believed the prestigious Wise Men of Science and did not verify if the complete optical astronomy project was feasible. And, soon, it was disclosed as infeasible. The DDR Party demanded that the Country paid huge fines for the contract breech compensation. The Prime Minister of the Country asked, personally, the First Secretary of the DDR Communist Party for reduction of the fines but that did not help too much: very high fines had to be paid by the Country to DDR,

The Polish Communist Party Secretary of that time, Wladyslaw Gomolka, liked to control, in detail, even smaller projects than that of the Nicolas Copernicus Birth Anniversary. Therefore, he had under his control the projects under discussion. When the Secretary learned about the contract fines, he got angry as a hell and ordered to cancel both the radio-astronomic and optical astronomy projects. The radio-astronomers tried to convince the environments of the science that the DDR fines were lower than the total foreign money investments in the Michelson Interferometer but there was nobody brave enough to try to convince the First Polish Communist Party Secretary that this project should be continued. And it was not. And the results obtained and discussed in [36] were smaller than those planned for the Copernicus Birth Anniversary.

5. Post-Mortem Discussion

The fates of the two basic characters – the definite pioneers of CCS in the Country. The first of them was Willy Wojsznis, the Consultant of the present article in the CCS domain. He was offered the General Designer position in his Control System entity (Elam). However, a General Designer is not any Designer at all and Willy lost his advantages of the first successful CCS Leading Designer in the Country. Many his ex-colleagues envied him his successes and experience gained in the Steel-Bar Mill and tried to harm him. In particular one of them (perhaps a member of (PoP)-s); at least he behaved as a PoP) discriminated Willy most and the latter decided to leave Elam. He had series troubles to find a good work for him so he decided to emigrate. For some time, he toughed and upgraded African students and, finally, moved to the USA and was employed by Fisher Rosemount (presently Emerson), and, after successful completion of a difficult individual task, he was granted various high level positions not including the leading designer one in CCS (like in the Steel-Bar Mill). And his biggest CCS experience and knowledge was not used in his Country.

The other experienced CCS Leading Designer, Bogdan (Józef Bohdan Lewoc) decided to leave Elam earlier than Willy, when he heard comments: Bogdan was capable of designing of hardware and writing of its software similarly to Willy and, in addition, he was brave enough and ready to tell the full truth to the Metallurgical Plant Management and to be successful in running the Trial Run till completion. He completed Mathematics (with distinction) and was capable of complex system investigation. A common conclusion: Almost a genius. Bogdan was not happy in full: Why almost?, and he left to the Institute for the Power System Automation (IASE Wroclaw) to lead and, in fact, manage CCS for the Power Industry.

At that time in the Country, due to the rules implemented by the Big Brother (Soviet Unit), any adult human being had to take extra work (called fucha in the Country) to leave at a comfortable level. Bogdan’s colleagues, ICT people like him, chose ICT as the domain of the extra work. Bogdan continued translation and due to that he was financially independent from PoPs. The best example of this was that he could safely refuse to accept a project of nuclear core computer system design since the project was not safe, though his superiors were very much interested in it since the money for IASE was very big.

6. Conclusion

The paper shows the WPR system (komuna) discriminated the real pioneers in the Country, in order to substitute them by their own people being compliant and completely subordinated to the system.

The approach adopted by Bogdan (complete financial independence of WPR and its executing forces, PoPs, seems to be the best way for long-time and successful work for the Country.

The first Polish CCS proved that such systems could be designed, developed and implemented successfully by Polish designers, with use of home hardware and software (Odra 1204 computer).

The paper shows that even the best scientific/technical solutions could be spoiled by incompetent WPR and PoP representatives.

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