TURNING POINT IN COMPUTER INDUSTRY: IBM APPEARS ON THE MARKET

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1. SUMMARY

In this article I will argue for the hypothesis, that behind a complex technological artifact such as a computer, we will find well organized groups with leading personalities and not just talented inventors "as founding fathers."

In order to uncover and analyze the interactions among the relevant social groups and the group-dynamics, I will apply the methods of Social Network Analysis (SNA).

From the rich scope of SNA methods I have selected those that are in my view suitable (based on the available data) for analysis within groups and the interactions between groups, for the quantitative measurement of the actors' activity.

Keywords: SNA, history of computing, computer industry

2. INTRODUCTION

In the followings I will examine the process of computer development in the USA between 1930 and 1952.

The aim of the article is to shed light on the fact that by examining the computer development in more detail, using a well chosen technological frame system (also applicable to the development of computers), there is an opportunity to examine the social projections of the developments.

This kind of analysis is also justified by the fact that the specialized literature, which is characteristic of the mentioned period, is limited to technological details, heroic stories and disputes on priority. In the specialized literature dealing with the period there is no word about the social need for the machines as a development motivating and affecting factor, however, this kind of investigation is more characteristic of the period beginning with the appearance of personal computers and formed by informational technologies, the second half of the 20th century (e.g. [7]).

With the analysis of social networks, the main objective was uncovering the interactions of the relevant social groups in the analyzed period. Since the representation of the a social networks of the whole 20 year period in a single network veiled the possible deductions concerning group dynamics, it was only expedient to list the relationships along some kind of time line, taking into consideration the beginning and the end of relationships [5].

Thus three sections could be distinguished in the time interval lasting from 1930 to 1950 according to relationships and group rearrangement. In the various intervals we can keep track of IBM's relationships, changes in its network position. From embracing H Aiken's idea in the 1930's, by providing the output/input devices used for building the ENIAC, it got closer and closer to the principle of general electronic digital computers from the production technology of the traditional punched card IBM machines. By the beginning of the 50s it had reached such an advantageous position in the network, that it was able to access all the previously heaped up knowledge and information needed for building, developing the electronic digital computer, which from the aspect of network analysis, can be interpreted as the condition for independence and later successes.

3. ACTORS OF THE NETWORK

In order to find out and analyze the interactions among the relevant social groups and the group-dynamics, I will apply the methods of Social Network Analysis.

A social network is a set of actors (or nodes, or agents) that may have relationships (or edges, or ties) with one another. For the manipulation of network data, and the calculation of indexes describing networks, it is most useful to record information as matrices. For visualizing patterns, graphs are the most useful. There is no single "right way" to represent a network of data with graphs. Different ways of drawing pictures of networks of data can expose diverse features of the social structure [10].

For visualizing graphs I used NetDraw[1], which is distributed along with UCINET software.

In order to identify the actors and their social network, I have analysed primary and secondary sources as well. First of all I have focused on the computing pioneers' work (e.g. [1], [3], [6], [8],[13]: the memoirs of Bigelow, Burks, Eckert, Everett, Mauchly, Rajchman, Ulam) but as primary sources I can mention here the oral history database of the Charles Babbage Institute Collections (http://www.cbi.umn.edu/oh/index.phtml).

In order to achieve an overview of the relevant events in the mentioned period of time, I have studied as secondary sources the works that other historians have written about the early computer development in the USA (e.g. [2], [4], [9],[14]). During the analysis our focus is on the IBM Corporation, and its changing position on the network. We can divide the above mention period of time into three distinct parts.

4. FIRST CONTACT WITH PRINCIPLES OF ELECTRICAL- DIGITAL COMPUTING (1930-1940)

Based on the mentioned resources the following institutes can be considered as relevant social groups in this period: Bell Laboratories, Harvard University, IBM, MIT (Massachusetts Institute of Technology) and Iowa State College. (Figure 1.)

IBM came into contact with computers in connection with the developments at Harvard in the 1930s. At that time, the IBM Corporation was led by T. J. Wattson. Its main intention was to get into the academic circles. Amongst others, this can be exemplified by the gesture when, in the name of IBM, Thomas J. Watson donated the Automatic Sequence Controlled Calculator to Harvard University on 7 August, 1944 "as another sign of the interest of IBM in science".

5. GETTING INVOLVED IN THE FIRST ELECTRICAL-DIGITAL COMPUTER DESIGN: 1940-1944/45.

In this period the reasons for collaboration among various institutes were largely influenced by the wartime demands. Before getting involved in the ENIAC project, IBM had not been interested in electrical- digital technology, its various well-known and widely used electromechanical machines were marketable, there was no reason to change its technological policy [11].

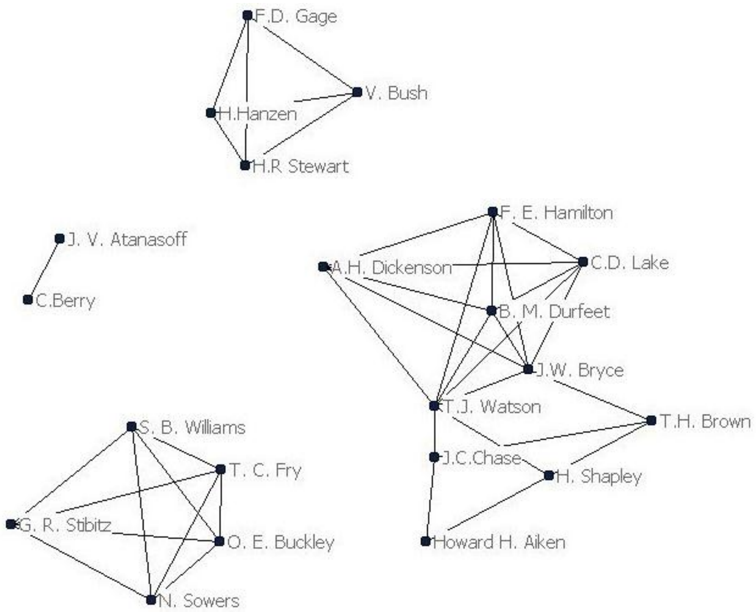

Figure 1.
Network: 1930-1940

[1] Available from the website: http://www.analytictech.com.

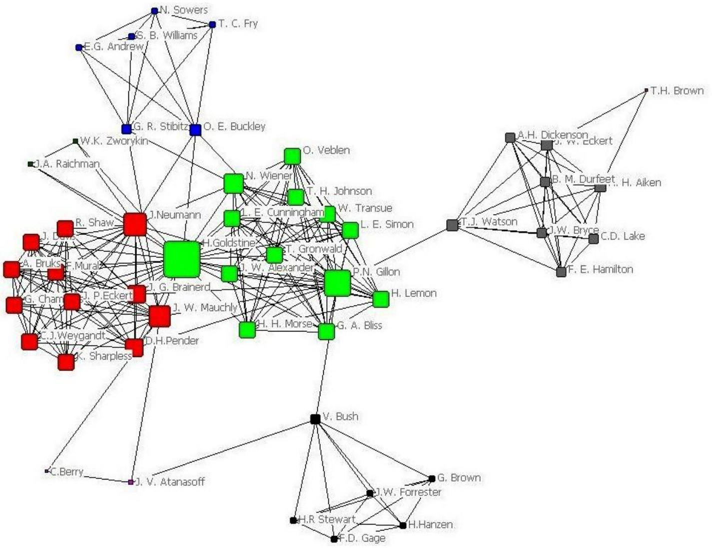

Figure 2.
Closeness centrality

1944 was a memorable year when IBM, again responding flexibly to the new ideas, helped to design and to develop the input and output devices and the units for printing out the results for ENIAC. We can record this collaboration as an occurrence, that led to the turning point in IBM's business and technological policy. In the followings we try to analyze the IBM's position in the mentioned group, and to disclose the hidden components of its victorious outbreak from the competitors' network.

The closeness-centrality as an indicator shows how 'simply' we can get from one randomly selected node to any other node in the network. (Figure 2.)

According to the closeness -centrality calculation, the network reflects that the persons with the most connections are the members of the Ballistic Research Institute's Board of Counselors, H. Goldstine and Paul Gillon being the most prominent among them. The persons we usually refer to as the 'founding fathers of computers', come only after them.

While in the USA it is Mauchly and Eckert, who are famed for being these persons, the Hungarist camp and believers in the principle of 'computer-building is for all' would unequivocally give this title to Neumann.

Based on the complexity of the network we can conclude that even the persons neglected up till now, but belonging to the team that had built the computer of the era (ENIAC) and elaborated the technical- mathematical- and logical foundations of modern digital computer building, also play an important role.

If we examine betweenness-centrality, we get Fig. 3. With this index we can answer the question of: who are the actors with the biggest power in this period in the analyzed network, concerning the whole network (not only concentrating on the number of connections within the groups)?

T. J. Wattson as a *"date hub"* collects his partners and forms complexes with different subsets at different times. He is a bridge between IBM and Harvard University, between IBM and Ballistic Research Laboratory (BRL), and also has indirect connections to members of different groups. Although he is not in the most favorable position (compared to P. N. Gillon, H. Goldstine and J. W. Mauchly, J. Neumann) in the network, he has a direct link to the P.N. Gillon who occupies a central position in the network. In this way his group can reach every member relatively easily and quickly and does not need to involve any other actor, for instance, to gather information. On the other hand they also have the opportunity to influence the dynamics of the network, its future structure and the key positions in the network related to the betweeness, closeness and centrality measures. The information flows from this position, the "know how" transfer can be easily supervised and accumulated in the long run.

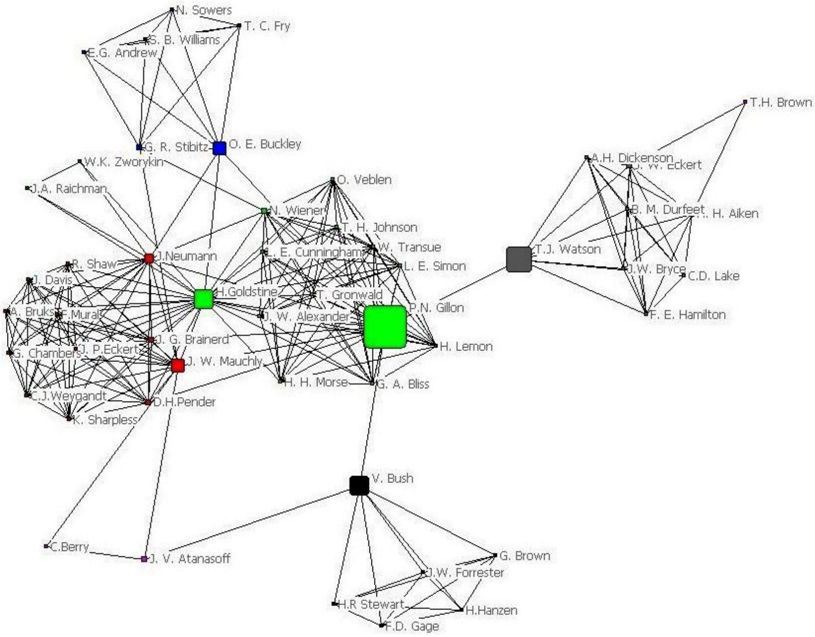

Figure 3.
Betweenness centrality

The IBM Corporation responded flexibly to the scientific and economical needs of the given period and learned how the technologies, being mostly able to adjust themselves to the needs, can remain capable of living in the competition.

6. THE REAL COMPETITION: 1946-1952

The most striking feature of this period is that the network is practically built up from three equivalent modules and the 'network' consisting of the ENIAC's two leading engineers.

The BRL as a motivating-financing actor no longer represents power in the network, the Moore School, as an educational institute utilizes and applies the acquired knowledge and experience for educational purposes, while the two leading engineers of the ENIAC, trusting in their expertise, as solid foundation in the field of computer design, found their own company.

Grouped around J. Neumann, T.J. Watson and J.W. Forrester, the network goes through a transformation, a lot of actors are left out compared to the previous period, or we simply find them in a different module compared to the previous ones. It can be clearly seen from the figure, that Neumann is the link between the MIT and IBM, there is no direct connection between the groups. The IAS group does not only take the central place in the network in this sense, but has also played the central role during the development process in building the universal digital computer and mapping the fields of its scientific applicability. (Figure 4.)

If we wish to check the work of these groups based on technical-historical accounts, the facts support the results that were derived as conclusions from the network structure: namely, that the modules which can be characterized by the same structure, *'network of connections'* are equally successful as long as their field of interest is common.

The MIT group following the trend represented by IAS, IBM and Forrester is equally successful between 1946-1952, produces unique products in their own way, but the "know-how" utilized for this rests on common base pillars. The IAS machine is completed in this period, the MIT group is working on project 'WHIRLWIND I', which can be considered as the foundation of the SAGE system, while the IBM builds the Defense Calculator, which can be seen as a transition between the computers designed for use in the scientific/arms industry and personal computers.

Comparing the groups' connections it is clear that the IBM's groups have the densest system of connections, which explains the derived result. When checking the result based on historical sources, we find that it is at this time when T.

Watson Jr. appears, along with a new intellectuality. Around him, as around a new node a second network is formed within the IBM network, which, consciously or not, copies the events of 1940-1946 into the network.

Just to highlight a few: as an analogy to the scientific counseling committee established in the BRL, the Watson laboratory is created with the first PhD awarded IBM employee at its head, none other than J.W. Eckert, who we saw in H.H. Aiken's group between 1940 and 1946 at Harvard.

Another similarly recurrent event in the network consists of the efforts made to fulfill the wartime demands. With the break-out of the Korean War, T. Watson Jr. and his team contacts all of IBM's earlier customers with government or arms industry serving background. As a result it is commissioned to build a newer computer also fulfilling the wartime demands, which is completed in 1952 named the Defense Calculator.

7. SUMMARY

Consciously or not, IBM Corporation has exploited the prospects of the bridge-like connections.

At last a few conclusions can be drawn from this case study by means of the SNA:

1. The information flows, the "know how" will be transferred in the network along bridges connecting individual groups (Watson, Neumann, Gillon, Goldstine, Forrester).
2. The more bridge-like connections exist in a given group the higher is the diversity of the group which provides an innovative environment, and thus makes the probability of the success of the synchronized actions with an aim to reach the common goal (ENIAC).
3. Structurally equivalent groups have the same chance to create successful products (AC, IAS, Whirlwind).
4. The innovations of isolated persons and/or groups remain resultless and echoless until they will be rediscovered by groups in the strategic nodes of the social network (Atanasoff, Berry).

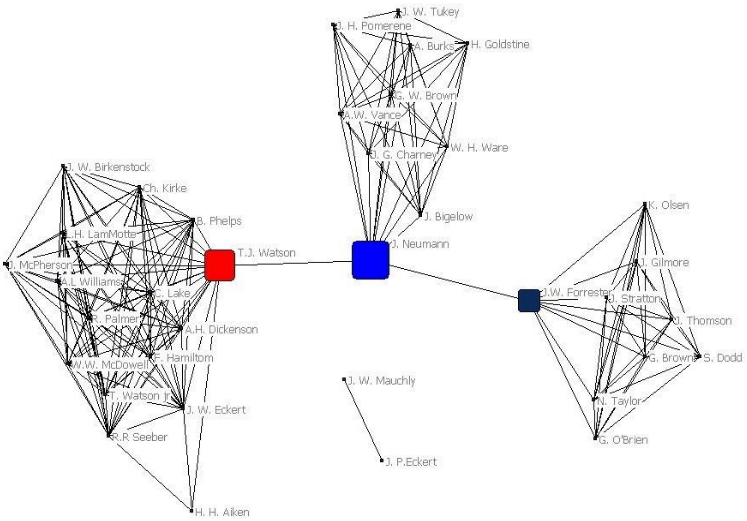

Figure 4.
Network: 1946-1952

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