The Digital World 30 Years Ago

Technology & Intelligence Integration

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Some time ago, I was assigned to think about what actions the company should take based on how digital transformation (DX) is expected to develop over the next 30 years. While this type of research and forecasting of course allows one to imagine the future to one's heart's content, I thought it would be useful to reflect on how things were 30 years ago and how they have changed over the past 30 years.

First, let's take a look at the field of supercomputing, including computational fluid dynamics (CFD), which is my specialty and the main field of scientific computation, both 30 years ago and today. Three decades ago, the term "IT" was not used, and what is now called IT was referred to as "computerization" and other terms.

Scientific computation of 30 years ago

- Basically, this was the golden age for vector supercomputers. Following CRAY-1, the U.S.'s vector supercomputer that was the first in the world to enter the market, Japanese companies released vector supercomputers, and major universities and companies owned them. IHI also introduced a model called VP-50, and the technical calculation engineers, including myself, were working to "vectorize" (rather than parallelize) their in-house programs.
- The number of computational grids for fluid calculations ranged from one hundred thousand to at most 1 million.
- The UNIX-based engineering work station (EWS) entered the market. However, it was a different world from Windows-based PCs, so we needed to acquire artisanal skills such as the ability to use "vi" (the standard text editor for UNIX).
- For the connections from the terminals at each office to the supercomputer (Toyosu, Tokyo), we used an in-house leased line originally reserved for administrative calculations. To transfer data from there to EWS for post-processing, we used telephone lines. To prevent the corruption of binary data during communication, we wrote out and sent the data in text format. The Japan team competed in the America's Cup, the world's most prestigious yacht race, for the first time in 1992, and IHI computed the flow around the ship hull. The supercomputer we used at that time was provided by Recruit Co., Ltd. (Shimbashi, Tokyo), and we shared grid files and calculation results between the supercomputer and our computer (Yokohama, Kanagawa) by magnetic tape via parcel delivery service.
- Though it had become also possible to display calculation results graphically, in the beginning, we needed a dedicated system to do so, and later the aforementioned EWS. To save images, we had to make slides by setting up a tripod in front of the display and taking photographs directly with a film camera, or make color hard copies with a very slow hard copy machine (it was impossible to store images electronically).

I remember the following conversation from those days. For an initiative called the "Materials Research Delegation" (1990) of the Research Institute, I asked the in-house materials experts if there was something like "computational materials engineering." They replied, "You need to stretch

materials to understand them; otherwise, you won't." When I visited leading researchers in Europe and the U.S. as a member of the delegation, I found they had adopted a similar stance.

Scientific computation of today

- The supercomputer "Fugaku," installed by the Japanese government, is in operation. It is a parallel computer consisting of 158 976 nodes (≈ CPUs).
- Fluid calculations on the scale of 100 million computational grids are nothing unusual. In the field of fluid dynamics, however, scientists/engineers usually run calculations with scale and complexity suitable for the current computer to "complete overnight" so feeling of the increase in speed is not very noticeable.
- Thirty years ago, the dominant fields of the scientific computation were fluids and structures, but other fields, especially those other than computational mechanics, are now also thriving. The field of materials is also a major area of interest. The most thriving at present may be the biological and chemical fields.
- Capacity computing (processing a large amount of calculations) has become possible, enabling the visualization of a large amount of results, optimization, and evolutionary computation.
- Data used to mean "calculation results," but today it means "meaningful sources and groups of information" that are worthy of exploring in their own right.
- The Internet is used for data transmission.
- Supercomputing is now also called high performance computing (HPC).
- Note that people only started talking about AI and data for HPC such as Fugaku when they started planning the Post-K (i.e., Fugaku) development 7 to 8 years ago.

In this way, we can summarize the field of supercomputing as a normal evolution of industrial products: becoming faster and larger.

Meanwhile, the IT, ICT, and platforms that serve as the foundation of digital transformation were in a completely different situation 30 years ago than they are today.

IT, ICT, and platforms 30 years ago

- Among GAFAM, only Apple and Microsoft existed. Both were making stand-alone PC hardware and software (Mac, Windows).
- Companies usually did not provide each employee with a PC.
- Although there were NTT-leased lines for large companies (e.g., IHI), the concept of the Internet did not yet exist.
- There was no e-mail. We used landlines or paper mail (contact forms) for internal communication. We also used fax machines.
- The concept of "Googling" something on the Internet naturally did not yet exist. At libraries, one could use the telephone line-based paper retrieval system provided by JICST (the Japan Information Center of Science and Technology) called "JOIS."
- All Internet-based services and platform businesses naturally did not yet exist.
- The IoT equivalents were analog data recorders, early data loggers, or dedicated computers that were directly connected to the target. Naturally, we needed to retrieve data offline. Of course, plants had large-scale data collection and display mechanisms already.

IT, ICT, and platforms today

I may not even need to write about this. AI has been spreading and developing at a furious pace for several years. This has resulted in arguments for and against it, with some people worrying that AI may take jobs away from humans. Amid this trend, ChatGPT, a chatbot based on a natural language generation model, quickly became very popular from the start of 2023, causing a sensation; people are saying that it may change education and other industries around the world (For your information, I did not use ChatGPT to write this article).

What happens next?

What will digital transformation — or rather, society insofar as digital technologies are considered — look like 30 years from now?

Normal evolution will continue in the fields of scientific computation and HPC. Although quantum computers are only now emerging and it is difficult to predict what they will be like 30 years from now, it is unlikely that they will replace conventional computers for many types of technical calculations, such as those we need to do at IHI.

Meanwhile, what will happen in fields other than computation? It is hard to predict whether the kind of revolution around the Internet that has taken place over the past 30 years will occur again.

I read an article somewhere which says "Before their advent, it was impossible to define Uber and YouTube. If you had asked me to write a business plan for YouTube before its emergence in the 2000s, I could not have done so," and I deeply agreed with it.

I look forward to seeing developments over the next 30 years while trying not to fall behind. And if I get a chance 30 years from now, I would like to write another short essay reflecting on the present.

(The photo is from the time when we explained the cutting-edge simulation technology/equipment (EWS) to the then Emperor of Japan (the current Emperor Emeritus) when he visited us in 1992. The panel on the right shows a flow analysis of spaceplanes, which were being vigorously researched and developed around the world at that time. Source: In-house Newsletter "IHI," July 1992 issue)