

North American Socio-Economic Network Tenaciously Cultivating Technology in Relay

Executive Summary

1. Introduction: Over the basis not allowing bloom of Japanese technology Despite Japan has achieved results attracting worldwide attention for their basic elemental ideas and technologies (described later) in the "neural network" (machine learning AI) and the "quantum computing," why have they not been commercialized? Referring to GPS, CDMA mobile radio, and AI as well as the Internet, the 2017 research report "Military/university/venture's breakthrough power seen in American innovation" (March 2018) examined how the U.S. military and national policies prepared the "foundation" (platform) in which ventures, which have achieved worldwide monopoly since the 1990s, grew. However, problems and tips do not end with U.S. "military-industrial-academic" cooperation alone. It's not the case that only the military and government bring about a worldwide venture. Naturally, venture capital (VC) also attracts attention. However, there is a problem in a preceding stage, and it must be raised until just before the point where the technology turns into a venture so that it does not die in the middle. Saying the conclusion first, it is the starting hypothesis that society must become the situation of "when one door shuts another opens" with diversity and pluralism for that. Among the various factors that have brought about such diversity and pluralism, what is an operating point to be noted?

2. Additional observation of cases (neural network, quantum computer, and shale-related technology)

In order to introduce a new perspective, in FY 2019, we add research cases to the FY 2017 research, take up neural networks (one method of machine learning AI) and quantum computers, which are attracting the attention most today, and subordinately observe shale-related technologies¹ (omitted in this summary.)

(1) Neural network

The Hinton (Geoffrey Hinton) laboratory team from the University of Toronto, Canada, eventually encouraged the current global AI boom by an overwhelming advance (low false recognition rate) at the image-recognition convention Image-Net in 2012². Among

¹ Shale-related technology is an epoch-making technology that has brought about the impact on the U.S. to be a net exporter of oil and natural gas. The trend must be an important technology as a basic trend, although it is inevitable that it will be at the mercy of the momentary crude oil price. However, since Japan is originally not good at shale-related technology, it does not lead to the elucidation of why Japanese technologies do not fully bloom. In that sense, it was attached.

² Although certain AI systems in a broader sense, such as IBM's victory of chess at the 1997 Deep Blue and its victory by questions and answers system "Watson" at the 2011 game tournament, had steadily gained attention, the extensions alone were not able to bring about the impact as brought about by NN (due to symbol processing limitations, etc.)

machine-learning AIs, it uses the neural network (Deep NN) type AI that gradually advanced from the idea of the formal neuron adopting optic nerve as a model. It was the result of the method called Deep NN because of using multilayer neurons.

Furthermore, for the backward error propagation (backpropagation) method, which is said to have been the most significant breakthrough in the NN technology, the 1986 publication by Lamelhart and Hinton et al. is famous. However, Amari had proposed the prototype in 1967, almost 20 years before. NN also has various processing algorithms. The convolutional neural network (CNN: Convolutional NN) is suitable for learning and recognizing images, characters, etc. Several research cases, including Hinton et al., were published from around 1987 to around 1989. As for this, however, Fukushima invented the neocognitron (neural network for pattern recognition with displacement) almost ten years ago, in 1979. In this way, even in the case of NN-type AI, a number of breakthroughs in the fundamental parts, which cannot be handled as a trivial element, have been proposed by Japanese researchers first in the world (representative cases only.)

The Japanese government, especially the Ministry of Economy, Trade, and Industry, the Ministry of Education, Culture, Sports, Science and Technology, and the Ministry of Internal Affairs and Communications (former Ministry of Posts and Telecommunications,) launched large-scale AI projects to recover from inferiority from 2015 to 2016. However, why does Japan, which was first in the world, have to recover from inferiority now? It cannot be done by saying no perception. Although the details are not shown here, AIs such as NN cannot be evaluated unless they are made into a kind of system by assembling basic techniques and various elements until the results become socially practical. Only when the whole is formed and positioned in it, the elements can be evaluated. If this is the case, a tenacious trial and error period is essential in which various element proposals are combined with various technologies without dying. Since the breakthrough by Hinton et al. was issued under the name of the University of Toronto (Ontario), it is apt to be taken as an achievement of a single university. However, in fact, the existence of a non-profit research organization called CIFAR (CIAR at that time), which was different from a university, was critically important. CIFAR (Canadian Institute For Advanced Research) or the original abbreviation CIAR (Canadian Institute for Advanced Research) was founded in 1982. The concept was proposed by the President of the University of Toronto, and the headquarters are still located in Toronto³. In CIFAR, social "issues" are set up, themes for their realization and elucidation are identified, and not only the university's laboratory but also university laboratories in various places in Canada are brought together to advance them.

Furthermore, researchers worldwide are invited to participate in the project, and themes are set up in an interdisciplinary research form crossing multiple domains and fields. CIFAR was purposely set up in an independent form outside the University of Toronto to realize such vision. The first point to be noted is CIFAR's revenue composition. In other words, the background was private nonprofit foundations, or more correctly, in particular, corporations called "private, grant-making foundations," funds having no corporate capacity or wealthy benefactors. Today's CIFAR, with the success of Hinton et al., is positioned as the "All Canadian AI Strategies" control tower of the federal government. Now, about 80% of its revenue comes from the federal and provincial governments, with only 6% from private foundations and the rest from enterprises, individuals, etc. However, out of about 8.5 million Canadian dollars (a little more than 700 million yen) collected by the people concerned in

³ Refer to the main body of this report for literature data. Although there are many descriptions in the CIFAR's HP or Wikipedia, the past background considerably traced back is not described.

the five years after its foundation, nearly 70% came from private sectors with more than half from enterprises and wealthy individuals and a little less than half (30% of the total) from private financial groups. The key that CIFAR managed to raise as much as 70% of private fund despite the University of Toronto's (provincial) proposal was by private, grant-making foundations and wealthy individuals (for many enterprises, related to their own business-related.) Regardless of calls from local industries, it gives an overwhelming impression that a large number of private foundations contributed to CIAR (at that time), which did not achieve any results at that time⁴. The second is the uniqueness in the selection of technologies and researchers. Under private supports, CIAR at that time launched the "AI & Robotics" as its first project (12 years from 1983 to 1995.) At that time, Hinton et al., who were still at Carnegie Mellon University in the U.S. at that time and purposely focused on NN, which was a different alternative (dark horse,) rather than centering an expert system, which was the center of the global AI boom in the 1980s, were invited to the project. It is fruitless to follow the countries, such as the U.S., Europe, and Japan, in the expert system, which was considered the favorite. Therefore, it can be understood that they aimed for a niche. Even the invitee seemed pleased to accept the offer provided in a situation where it was pressured by their favorite (expert system at that time.) Hinton expressed his deep gratitude to CIAR (today's CIFAR.) During the project, Hinton et al. achieved a series of results, such as the "restricted Boltzmann machine" in 1985, the "backpropagation" in 1986, and the "convolutional NN" in 1987 to 1988. Finally, Hinton left Carnegie Mellon for the University of Toronto in 1987, partly because of their connection with CIAR⁵. Furthermore, in the 1990s to early 2000s, AI was in a worldwide decline due to the limitations of the expert system, which used to be the favorite. At that time, CIFAR launched the "Neural Computation & Adaptive Perception" project in 2004 to start to support NN. Because of this, Hinton brought Lucan from France to Toronto in the form of postdoctoral studies. Three DNN players of Hinton, Lucan, and Bengio gathered in the CIFAR Hinton laboratory and the University of Toronto, even if it was temporary. Under the situation, Hinton et al. incorporated the 2006 "lamination self-encoder" (stacked autoencoder) technology and completed a series of DNN technologies, such as enabling data dimension compression, in a general way. All they had to do after that were to accumulate image data and improve computing capability. They achieved success in 2012⁶. Then, what is the "fifth-generation computing" plan in Japan?

CIAR (at that time) was established in 1982, and the AI project was conducted from 1983 to 1995. During the period, the "fifth-generation computing" plan (from 1982 to 1992) was

⁴ The Azrieli Foundation, which is the private sector maximum contributor, was established by David Azrieli, which obtained great fortune from the real estate business of Montreal, Quebec, next to Toronto. Toronto and Montreal are famous for numerous Jewish refugees, with about one person in 20 Jews. Mr. Azrieli was also a Jew who fled to Montreal, where many Jews lived, after escaping Nazis and changing his address frequently. Needless to say, they did not support the Jewish people alone, and all foundations above are not Jewish. However, while not described in detail in the executive summary, Christianity and Judaism are considered to have a significant influence in terms of contribution.

⁵ The fundamental factor of this transfer was not CIAR. Hinton himself stated that he could not tolerate the U.S. and decided the transfer (renouncement of nationality) partly because there was the Iran-Contra affair under the Reagan administration at that time. The major reasons why the destination was Toronto are considered to be that Toronto is comparatively close to Pittsburgh and that he had participated in the Toronto CIAR project since 1983. Naturally, it may have favored Hinton from the U.K. that Toronto (Ontario) was the English-speaking world composed mainly of English lines, different from Montreal (Quebec), the French-speaking world.

⁶ The evaluations that DNN was possibly realized by the data accumulation and the computing capability improvement are found here and there. However, it is obvious that it ends in mere rubbish unless there is a processing algorithm system (a combination of various elements) of "how they are used."

conducted by the Ministry of International Trade and Industry in Japan in a mostly parallel form. The national expenditure of more than a total of 50 billion yen was invested in the inference system (including not only HW but also SW) development of a logic and symbol processing system supposing the knowledge base, such as an expert system, etc. which were seen as the favorite at that time. Unfortunately, it cannot be said that the result was a global success. The policy was seemed to be changed not to pursue a magnificent system such as the "fifth-generation" in the subsequent "real world computing" plan (from 1992 to 2002,) and the whole (so to speak a building) was not said to be unsuccessful. However, it seems to have concentrated on accumulating comparatively small individual results from beginning to end without fully using the Internet, which had just started. As mentioned above, after that, CIFAR rather has tenaciously adopted NN again since 2004 and extended it eventually. CIFAR continued to support NN exceeding a total of 20 years, although it was not continuous.

(2) Quantum computers

Although it is simplified since there are many fields similar to NN, in a quantum computer (a quantum gate system and a quantum annealing system,) Yasunobu Nakamura (NEC fundamental research laboratory at that time) et al. achieved the result attracting worldwide attention (aiming at a quantum gate) in the demonstration of a superconductivity quantum bit, etc. in Japan in 1991 or 2003. On the other hand, Nishimori, Moriwaki et al. of Tokyo Institute of Technology achieved a significant result in quantum annealing in 1998. Further traced back, in the hardware and devices, which are indispensable when realizing them by using superconductivity although they are different from the quantum computing algorithm, etc., even Reina Esaki, Nobel prize laureate, can be mentioned. However, again, for superconductivity quantum annealing, the Canadian venture, D-Wave (around Vancouver on the Pacific coast,) established in 1999, achieved the shipment of annealing machine products over about ten years (2011) and the result attracting worldwide attention. Subsequently, in a quantum gate system, in 2019, Google-a UC-Santa Barbara team announced that it eventually achieved "Quantum Supremacy⁷." Despite skeptical comments from IBM etc., it must be an epoch-making event.

In 2019, again, the Japanese government created the road map of technical development, including other quantum related technologies, in the form of a following and secured a large-scale budget (this paper does not intend to make comments.) Despite that it is a repetition, the problem would be that in spite of multiple considerable technologies proposed in Japan, they are not succeeded, and the situation of being panicked later is repeated. Up to the product announcement, D-Wave was mainly supported by local community funds (investment) with the provincial government-related financial institutions in the area around Vancouver (British Columbia).

The NN type AI, and the quantum computer were observed above. D-Wave, which is a profit pursuit venture, aims at product development. Therefore, the phase (stage) is different from the NN mentioned above, and the contributions by private foundations supporting scientific research such as CIFAR do not stand out. However, a community foundation and a private foundation are the same in terms of a private financial group (or the fund financed by a private sector.) In short, the fact was confirmed that a "private sector" stands on its own feet to countervail the "government" and has supported the bud of technology with uncertain feasibility for about 10 to 20 years.

⁷ Refer to the main body of this report for details.

3. "Private sector nonprofit fund" continuously supporting technologies from germination to bloom as a member of society

The following points are extracted from the preceding clause: It is said that the stockholder's equity principle pursuing short-term profits spreads in North America (or "the Anglo-Saxon type" including the U.K. as commonly referred to) including Canada (this paper does not intend to verify it.) That may be what it is in terms of large-scale investment, the investment after the second stage for a venture. However, it was a conclusive factor that funds and activities of "private sectors" have tenaciously supported science and technology in an earlier stage over many years while individual supporters were changed. Since earnest investment to pursuit profits is needed later, it must be a follow-up unless the preceding stage does not grow. Although it is a repetition, the "sociality" of the area outside the capitalism region, which allowed "private sectors" to make technologies that the "government" did not respect live long without dying in the middle, should be noted. Naturally, this may not be a sufficient condition to success, only a necessary condition. The "fifth-generation computing plan" of the Ministry of Economy, Trade, and Industry, the Japanese government was mentioned. However, as often said, the problem over the "government-manufactured" project does not end even if the failure of the content technology is criticized. There may be an operable and significant problem (issue) in a project. However, more than that, it may have been a problem that the business and funds supporting alternatives scarcely came out from "private financial groups, funds, etc." other than government-manufactured plans (in the outside), even if the scale is small. In other words, it should be called to account that there is not a scheme that the private "society" other than the government has concern for science and technology to the extent that they pay money and support the diversity in technology over a long time.

It is not necessarily wise to distribute government-manufactured funds to many candidates. In some cases, it is effective to distribute resources to a specific candidate intensively. The propriety should be examined for each case, and a general conclusion possibly does not exist. Also, it is almost only an afterthought whether technical candidates' selection for each project was wise for the technology of which value is not clear without compiling elements into a system, such as AI and quantum computing. Probably, CIFAR's success is a kind of chance (accident.) This paper does not emphasize the point. We propose such a "social system" that even if CIFAR (its selected technology) is unsuccessful, another private financial group, etc., support another technology in the same way (CIFAR is only the example.)

4. At the end: Seeking for the Japanese-style possibility

It is a little operatable proposal to the government to provide hospitable supports to crowdfunding, not limited to the expansion of the tax donation system (range, etc.) and the angel tax system. The priority is to appeal to major private sector companies. The major private sector companies probably should not only invest in their companies' business-related investments, such as CVC (Corporate VC,) but increase the contribution to existing private foundations in Japan or establish and manage their own fund. The founders etc., who accumulated wealth must be suitable for it, and it is the case in foreign countries. However, as clear from the foundations, such as Carnegie, Rockefeller, Mellon, Ford, and Kellogg, the problem is as follows: All of them consist of the donations from individuals and

families who accumulated a large fortune and return all or part of the fortune later only to the part meeting their creed after accumulating the fortune as their own once. To put it the other way, the scheme works out just after an unbelievable huge income gap has been realized (religious influence is a problem coming up next, that is, only a problem of income's redisposal.) Is it desirable for an entire society? Since there is also a problem of the "degree and limit," it exceeds the discussion range in this paper. The "private sectors," which can countervail the "government," can be desirable, developing diversity and vitality. Historically, since a huge financial resource has exercised private right and tossed a nation, it does not necessarily bring a desirable result to the entire society. Besides, considering Japan, where a gap is less than the U.S., etc., it is questionable whether it is effective to seek a Western-style private foundation. If so, what kind of things can be considered? Isn't such a style suitable for Japan that the individual volunteers in Japan, where income was scattered widely and thinly, contribute to crowdfunding for business profit and the novel funds, etc., which escaped from old-fashioned "fund-raising" form for nonprofit? Although it is natural that the government, especially tax authorities, doubt purposely promoting private sectors asserting different opinions from theirs to themselves at times (including funds,) including a tax cut, it may be a little shortsighted. Not recognizing it as promoting the counters, but as what contributes to the even activation of government sectors under a sense of tension in the future, they should consider a novel tax system and the government's leadership exceeding Hometown tax and the angel preferential treatment system.

It is the same in private funds to universities. The present Ministry of Education, Culture, Sports, Science, and Technology and some university chancellors adhere to the commitment of "major companies." They do not have a social entrepreneur spirit to serve society. A private-sector nonprofit "fund," etc., which are not an enterprise alone and have a novel form, should be conceived. (The individual concrete plan is not this research's scope, for which a separate is required)