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‘It can’t be uninvented’ – the Dutch debate about the chip in the early 1980s

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Introduction

'It can't be uninvented.' With this motto, the new micro-electronics section of the Netherlands Institute for Industry and Technology (NINT) was opened on 25 October 1979 – itself an act aimed at influencing the general attitude of the public towards the new information technologies. According to the Dutch minister of science policy A. van Trier, this motto was the key element to understand how micro-electronics as a new political and societal issue should be approached. According to the minister, micro-electronics would prove to be able to have both beneficial and negative impacts on the Dutch economy and society.

> "It can create jobs but may also replace dirty and unpleasant work; it can be a blessing for our economy but also a plague; it may help people in education and may contribute to optimal care of patients; it may be a help or a burden; provide recreation or make us even more cavalier. This all may happen which means that we will have to learn to cope with it, at all levels and under all circumstances, in our work and at home."[1]

This double-faced nature of micro-electronic technologies made it imperative that people would learn how to handle the new contraptions that they would inevitably be surrounded with. This necessitated, according to the Dutch government, that a strong educational campaign should be conducted:

> On the one hand, we have to keep open options to be able to adequately respond to new developments, on the other hand we should try to prevent that micro-electronics overwhelms us as a tsunami and leaves us confused and disrupted. Notwithstanding the large publicity about micro-electronics during the last year, we still cannot say that the majority of the population is able to accurately tell what should be understood under micro-electronics."[2]

In other words, the inevitability of the further development of micro-electronics was seen as the backdrop against which the policy needed was sketched. This policy aimed first at bolstering the Dutch position in the international economic competition in which micro-electronics was seen as both a crucial instrument and a key domain in itself. However, this was not enough. In order to be able to become "a land of micro-electronics" as Van Trier had called it in an interview with Elseviers Weekblad a few months earlier[3], enough people in the country should be convinced that the chip was an opportunity well worth taking the accompanying risks. As we have seen, Van Trier

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[1] A. van Trier, Speech 25 October 1979, Maatschappijbelangen, NINT Amsterdam, 1 January 1980, RAWB Archive D/80-19: "Het kan werkgelegenheid bedreigen maar het kan ook vuil en onaangenaam werk vervangen, het kan een zegen voor onze economie zijn maar ook een plaag, het kan mensen helpen bij opleidingen en het kan bijdragen in optimale verzorging van patienten, het kan een gemak en een last zijn, verstrooiing bieden of ons nog gemakzuchtiger maken. Dat alles kan en het betekent dus dat we er mee moeten leren omgaan, op alle niveaus en onder alle omstandigheden, in ons werk en thuis."

2 "Thans reeds moeten we aan de ene kant opties openhouden om waar nodig adequaat op ontwikkelingen te kunnen inspelen, aan de andere kant moeten we zien te voorkomen dat de micro-electronica ons als een enorme golf overspoelt en ons verbaasd en ontredderd achterlaat. Ondanks de vele publiciteit van het laatste jaar over micro-electronica, kan bepaald nog niet worden gezegd dat inmiddels de meerderheid van de bevolking nauwkeurig kan vertellen wat we er onder dienen te verstaan."

3 "Nederland wordt elektronika-land", Elsviers Weekblad 14 July 1979, RAWB Archive D/79-263.

did not deny the existence of these risks but he tried to frame them in a way that would help prevent opposition to large-scale application of chips to become too strong.

> The spread of some understanding about this is, however, an important issue. It can only come off the ground if many people contribute. A fairly large number of conferences and symposia have already been organised about micro-electronics and its societal consequences. Yet, this type of meetings tends to have a limited audience.[4]

The minister expected to receive a crucial report from a committee installed by his predecessor very soon. This report should help the government to reach a larger audience than these limited publics at conferences and symposia – often consisting of experts in related areas. The committee was seen as authoritative with respect to the assessment of the future developments in computer technologies and their impacts on Dutch society. It consisted of a number of respected public authorities and scientists and was chaired by a former head of the physics research laboratories (Natlab) of the largest Dutch-based company active in computers (Philips), prof. dr. ir. G. W. Rathenau. The government hoped that this report would enable them to develop "a careful policy" that tried to balance economic interests with public reassurance. Van Trier concluded his speech in November 1979 with a plea for an active campaign on the phenomenon micro-electronics aimed at enabling everyone to handle this "technical jewel":

> "But at the same time, understanding of the phenomenon micro-electronics will have to be spread among the public at large. And, I do not hesitate to repeat this at the end of my lecture, this is not aimed at having the people embrace the chips, but, on the contrary, to learn how to handle this little technical jewel."[5]

The Rathenau Report came out on 30 November 1979[6] and did indeed advise a policy of embracing the new technologies as opportunities for innovation, while at the same time proposing a concerted effort in technology assessment and in public information and education. The report has had a lasting influence on technology policy, although ironically not in the first place because of its concrete policy advice with respect to the chip. The way the government handled the report was a big disillusion for the chair of the committee who had spent 10 months of hard work drafting it. In fact, whether the report had any concrete policy impact at all can be questioned on good grounds. It took the government another 10 months to send its standpoint with respect to Rathenau's recommendations to the Second Chamber of Dutch parliament. And with respect to its implementation, almost all parties would later agree that the government did too little too late. Instead of a strong national center for micro-electronics that Rathenau had advised, three smaller centres connected with the three technical universities were created. The financial investment in these centres was moreover seen as one-tenth of the amount needed to propel the Netherlands as a land

[4] "Het doordringen van enig begrip hierover is echter een belangrijke zaak die alleen goed van de grond kan komen als veel mensen zich hiervoor inzetten. Er zijn inmiddels al een flink aantal congressen en symposia over micro-electronica en de maatschappelijke gevolgen ervan gehouden, maar ook dergelijke bijeenkomsten hebben toch een beperkt publiek."
[5] "Maar tevens zal begrip voor het verschijnsel micro-electronica in bredere kring moeten worden verbreid. En, ik zeg het aan het slot van mijn betoog nogmaals, niet om zielen te kneden om de chips massaal omhelsd te krijgen, maar - integendeel - om met dit technisch kleinood te leren omgaan."
[6] Its letter of recommendation is dated 5 November 1979.

of micro-electronics on the international scene. In many ways, the Rathenau Report can therefore be seen as a failure.

And yet, the Rathenau Report stands out in the history of technology and innovation policy in the low countries. So much so, that it made the principal author more or less immortal by naming an institute after him, the Rathenau Institute, presently an institute of the Royal Netherlands Academy of Arts and Sciences. The reason for this fame lay in the recommendations by Rathenau to create a systematic effort in technology assessment with respect to micro-electronics. This advice led to the creation in 1986 of the Netherlands Organisation of Technology Assessment (NOTA), modelled after the American Office of Technology Assessment. After a review of the functioning of this institute, it was reshaped with more emphasis on public debates about technology, and named after the by then deceased Rathenau. This has certainly contributed to the name of Rathenau being coupled to the organisation of rational public consultation and debate about the impact of new technologies.

Rathenau having thus been turned into a national icon of reasonable, rational discourse about socio-technological scenarios, makes his report a particularly interesting case study of present developments in the public understanding/engagement of science and technology (PUS/PES). In the following, we will take a closer look into what the report actually proposed and how these proposals were taken up in the public domain. We focus thereby not on the development of technology policy as such, but on the way public involvement was framed and organised. This is closely related to the conceptualisation of "micro-electronics" as a problem for and in public policy. We explore what issues were brought to the fore in the framework of this discussion, how actors were included and excluded, and what type of discussion fora, if any, were being developed. We conclude with how the resulting "public debate" can be characterised in the terms of the STAGE analytical framework .

The Rathenau Report: main points

The Advisory Group chaired by Rathenau spelled out its basic assumptions with regard to the introduction of new technologies in general before giving its view on the specific nature of micro-electronics. It took as "certain" that micro-electronics would be introduced in many areas of society, since "the Netherlands are part of Europe". It was however not of the opinion that technology development could be seen as autonomous, on the contrary. According to the report, technogical developments can only acquire the character of autonomy if society permits this, either out of negligence or lack of attention. It is the task of the state to take an "active position" regarding technology. The state's main task, according to the Rathenau Report, is regulation of the positive and negative consequences of new technologies. This entails that:

> again and again the question has to be answered whether the technology is the preferable answer to a particular problem. Choosing a technology should never be a default decision.[7]

[7] Advisory Group Rathenau, "Maatschappelijke Gevolgen Van De Micro-Electronica," (The Hague: Staatsuitgeverij, 1980), p. 8.

Nevertheless, the future consequences of the introduction of technologies would never become predictable, in the eyes of the Rathenau Advisory Group. The relationships between technology on the one hand and society on the other hand were seen as too complex. Moreover, technology is in the last instance based upon creativity and inventiveness. This means, the report states, that government should not strive for a fixedset of policy goals. It should develop a flexible policy that takes into account the uncertainties, possibilities and risks that will always influence technological developments[8].

An important element of the Rathenau Report is its vision of the specificities of micro-electronics as a generic technology. This vision underpinned the attitude of the Rathenau Committee with respect to technology assessment. Micro-electronics was seen as both small and integrated electronics. To these characteristics, the report adds the print-based nature of the production process of micro-electronic components, which would enable increased scale-effects of mass-production, and its generic nature. Moreover, micro-electronics is seen as having no big impact on rare or expensive raw materials. Taken together, the Rathenau report takes these technical characteristics as the foundation for the role of micro-electronics as a social catalyst:

> "Due to the small scale and low price, technical and economic barriers can be taken that so far prevented continued automation. It is not necessary to be frugal with micro-electronics."[9]

On this basis, the Rathenau Committee expected that micro-electronics would function as "a catalyst of societal trends that have already become visible". It did not only expect acceleration but also qualitatively new changes:

> "Functions that so far could only be executed by humans may now come within reach of electronics."[10]

The report concludes that the Dutch government should develop a clear-cut policy of support for small and medium-sized companies in the form of an expertise centre for micro-electronic design. This knowledge and expertise centre should make companies aware of the potential of the new technology and how to deal with it in their enterprises. At the same time, technology assessment should become the main policy instrument to deal with the social and cultural consequences. These are deemed by the report as "the most important" aspects. In this strategy, education was seen as the most efficient instrument to steer societal developments.

Within this framework, the report includes extensive explanations of what micro-electronics was about. It contains photographs of microprocessors produced by Philips as well as diagrams explaining the difference between analog and digital technologies. Logical circuits dealing with the AND and OR operators are also included. The latest IBM 4300 processor, which had the astonishing capacity of 64,000 bits (64k), is compared with the somewhat older "Small Scale Integration" circuit which was capable of handling 2 bits of information. The reader learned about

[8] Ibid., p. 9.
[9] Ibid.
[10] Ibid.

Random Access Memory and its falling price in dollar cents per bit. The report even contains diagrams of the photolithographic production process, MOS-transistors, production masks, and last but not least artificial intelligence and robots.

In its discussion of the promise of the new technologies, the report's tone is optimistic. This changes rather abruptly in the section in which the Dutch integrated circuits industry is discussed. The question is raised whether the Netherlands could play a role in the production of micro-electronic components. Not really, the report concludes. Although the country was the main seat of the Philips company, the cards had already been dealt at the end of the 1970s. The main players were the US and Japan. Europe had three companies that played a role: Philips (with a production share between 5 and 10 %), Siemens (with a share between 2 and 5 %) and Thomson-CSF (with a share between 1 and 2 %). With the exception of Philips, the Dutch should therefore be modest in their ambitions with respect to the computer industry, Rathenau concluded. The main focus of governmental policy should be the application of micro-electronics in the innovation and quality improvement of existing products, new products and systems. Even for this more modest goal, the number of experts in the country were seen as too low. "Knowledge and expertise necessary to be able to recognise the possibilities and limitations is lacking", the report concluded[11]. Hence, education and training were seen as key elements of a successful policy with respect to micro-electronics. Part of the training initiatives should be aimed at small and medium-sized companies.

A crucial chapter in the report is devoted to the possible consquences of the micro-electronics revolution for the Dutch economy. The report analyses the economic impact of the new technology at three different levels: the macro, meso, and micro-level. The report tries to tackle three different questions. First, its goal was to estimate quantitatively the effects on the Dutch economy and the labour market. Second, it tried to assess the relevance of possible policy measures by the government. The third goal of the report was to discuss the relationship between economic, social and psychological aspects of the introduction of micro-electronics in Dutch society[12]. The chapter draws the conclusion that this introduction should be seen as

> "one of the most important changes in external factors influencing the Dutch economy. This change is probably comparable to the change after World War II caused by the mechanisation of the primary sector and the exploitation of natural gas in our country"[13].

The Rathenau committee commissioned the Central Planning Bureau to study the macro-economic consequences of a rapid introduction of micro-electronics in the Netherlands. This report was added as Appendix 3 to the Rathenau Report and was the main basis for the conclusions of the Rathenau Committee with respect to the impact of micro-electronics on employment. The CPB combined an economic model with scenario analysis. Three different scenarios were explored. Scenario 0 was the

[11] Ibid., p. 10.
[12] Ibid., p. 38.
[13] Ibid., p. 55. "De Adviesgroep is van mening dat de introductie op grote schaal van micro-elektronica in het komende decennium moet worden beschouwd als één van de belangrijkste veranderingen in de externe factoren, die de Nederlandse economie beïnvloeden. Deze verandering is waarschijnlijk vergelijkbaar met die welke na de tweede wereldoorlog zijn opgetreden door de mechanisering in de primaire sector en door de exploitatie van het aardgas in ons land."

base line and identical to the usual CPB scenarios. Basically, it assumed that technological progress would proceed at the speed of the 1970s (leading to a growth in productivity of 4 % per year in the model). In scenario A, micro-electronics was introduced at a high speed, both in the Netherlands and abroad. In scenario B, the Netherlands would lag behind, whereas other countries would introduce micro-electronics as fast as in scenario A. The CPB study draws two main conclusions from the computational representation of scenarios A and B. First, a rapid introduction of micro-electronics in other countries would have no negative consequences for the Netherlands if, and only if, it would join the electronics revolution and if enough compensation measures would be taken for the partial loss of employment. Second, scenario B clearly showed that the Netherlands simply could not afford to stay behind. Both conclusions were based on the assumption that introduction of micro-electronics would proceed at a fairly high pace in most or all competing countries. The CPB study mentioned that this assumption was "anything but certain". However, the Netherlands should be prepared to be able to follow scenario A, which asked for measures with respect to training and information[14].

The Rathenau Report concludes from the CPB study that a policy of wait and see or an attempt at slowing down the micro-electronic development would be unwise[15]. It combines the macro-economic analysis with a discussion of the consequences of micro-electronics in different economic sectors, partly on the basis of a survey in the year 1977. It draws the conclusion that the implementation of micro-electronic technology will lead to an unemployment of more than 300,000 man-years in the year 1990. One of the members of the Rathenau Committee even concluded that this figure was too optimistic and would be between 400,000 and 600,000 man-years. This level of unemployment was unacceptable for the committee. Extra measures were needed to prevent this rise in unemployment. The main measures the report advises are:

- adaptation in the educational system
- making the new technology available to those organisations that do neither have the expertise, nor the means to apply the technology themselves, specifically the medium-sized corporations
- a marketing programme to promote micro-electronic technology
- more technology assessment research
- economic measures aimed at supporting exports, alongside others limiting the rise of salaries
- an active procurement policy of the state to promote product and process innovation, aimed at the national economic market[16].

The key advise the Rathenau report gives in this domain is the creation of a national centre of micro-electronics. The rapid technological development asked for a pooling at the national level of the available expertise and knowledge. Universities, technical universities, the national technology research organisation TNO and Philips should

[14] Ibid., p. 123. "Als in het buitenland de micro-elektronische revolutie doorgaat, is de keuze voor Nederland beperkt tot de scenario's op de lijn AB. Het is allerminst zeker dat in het buitenland zoveel ME zullen worden toegepast. Als het echter inderdaad gebeurt, kan Nederland alleen dan scenario A volgen als scholing en voorlichting daartoe voldoende hebben voorbereid."
[15] Ibid., p. 46. "Samenvattend kan worden opgemerkt dat de berekeningen van het CPB aantonen dat een politiek van afwachten en/of afremmen van de micro-elektronische ontwikkeling een onverstandige politiek zou zijn."
[16] Ibid., p. 56/57.

work together. The Rathenau Committee saw one national centre as the best form for reaching the necessary critical mass. The centre should be staffed with at least twenty academic researchers plus support staff. The report gives three reasons why such a national centre should be created. The first reason is the lack of available expertise in micro-electronics and its related scientific disciplines. All experts should therefore cooperate. Second, research and development in this area has to make use of expensive and complex instruments that moreover have a short economic life-span. Third, a national micro-electronics centre should prevent that small and medium-sized companies might become dependent on the foreign electronics industry in case the Dutch industry would not survive. In the eyes of the Rathenau committee, the government should fund the national centre in the initial years. It did expect, however, that the centre would become self-supporting in the long run.

The Rathenau report devotes considerable attention to the discussion of the social and cultural consequences of micro-electronics. This chapter is a general overview of the interaction between computer technology and society outside of the economic sphere. It reviews the impact of micro-electronics on organisational structures and privacy protection and individual freedom, the consequences of the loss of employment on social and psychological relationships, and the possible impact on the quality of labour and labour environments. With respect to the protection of privacy, the Rathenau report refers to a report by another advisory committee, the State Committee Privacy Protection in the context of Person Registration[17], that had been working on this problematic between 1972 and 1976. This committee had concluded that a legal framework was needed to strike a proper balance between the interests of the individual and the collective interest with respect to for example the organisation of health care or the juridical system. The Rathenau Commitee underwrites this conclusion[18], but adds that micro-electronics will make it easier to couple databases and hence enable a surveillance that "society might experience as unbearable"[19]. Moreover, the specific software used should be taken into account. With respect to the effects of micro-electronics on the quality of labour, the report mainly draws the conclusion that more research was needed, given the many uncertainties involved. Society should also prepare itself to a more thorough debate about these issues, the Rathenau Commitee concluded.

These two elements, social scientific research and societal debate, come together in what can be seen as perhaps the most innovative element of the Rathenau Report: its plea for a systematic policy informed by and oriented towards technology assessment (TA). Technology assessment should be conducted by multi-disciplinary groups, mainly based at the universities and technical universities. The committee advised that the Scientific Council for Governmental Policy[20] should coordinate and commission the TA research.

The debate that the Rathenau Report advised was not so new. Actually, it was already going on, in the Netherlands as well as outside of the Netherlands. The report did not

[17] De Staatscommissie Bescherming Persoonlijke Levensfeer in Verband met Persoonsregistraties (Staatscommissie Koopmans).
[18] The Dutch government had not yet taken a position on the conclusions of the Committee Koopmans.
[19] Rathenau, "Maatschappelijke Gevolgen Van De Micro-Electronica,", p. 71. "Dit bespieden in optima forma kan voor de samenleving onverdraaglijk en verlammend zijn."
[20] De Wetenschappelijke Raad voor het Regeringsbeleid (WRR).

trigger a novel debate, it was rather an element, albeit an important one, of an emerging debate on the impact of the "electronic revolution" or "the chip" on society. The publication of Rathenau's report did certainly intensify the debate and made localised discussions among experts more visible. It was however not the origin of the public debate about computer technology in the Netherlands, but rather its momentary expression and articulation.

The Rathenau Report as a result of policy debates

The decision by the Dutch government to ask for a comprehensive advice on the societal consequences of "micro-electronics" can be understood against the background of a flurry of national and international meetings and publications. In 1978 the UNESCO had organised a conference on "Strategies and policies for informatics" in which around 70 countries participated. The OECD commissioned a number of studies in the programme "Government and Information Policy". The European Commission published the report 'European Society faced with the challenge of new information technologies: a community response' in 1979 and determined a long term research programme. In the same year, the French president organised an international colloquium with more than 2000 attendants under the title "Informatique et Societé". November 1979, his American colleague devoted the yearly White House Conference to the topic of library and information systems. Publication of the Rathenau Report took place in the midst of a host of symposia and conferences about information technologies and information policy in the Netherlands as well. In December 1979 and May and June 1980 the journal *Databus*[21], a monthly journal on micro-electronics technology, organised a series of lectures at the three technical universities, later published as *Micro-elektronics in the 80s*[22]. The department of the Royal Netherlands Academy of Arts and Sciences that was responsible for public relations and science popularisation, the *Department of Science Information*[23] published a book specifically aimed at providing the foundation for a societal debate about the "march of the chip", in which a summary of the Rathenau Report could at the last minute be included (the book was already on its way to the printer when the report was made public)[24]. On 10 April 1980, the Free University in Amsterdam celebrated its centennial with a symposium on "Computers in society". As already mentioned, the NINT created a new hall devoted to micro-electronics in October 1979. This went hand-in-hand with meetings by industry associations about all sorts of computer applications to innovate processes and products.

So when the Rathenau Report was made public it did not trigger a public debate de novo, but was rather itself the product of an already ongoing debate. From the documents it is not entirely clear what departments within the Dutch government were mainly responsible for forming the Rathenau Committee. It is clear, however, that the interests of industry were actively represented from the very beginning. Micro-electronics was seen as creating important new economic opportunities, both for

[21] *Databus – maandblad voor microcomputer-techniek.*
[22] NN, "Micro-Elektronica in De Jaren '80" (paper presented at the Databus Symposia, 1979).
[23] *Dienst Wetenschapsvoorlichting.*
[24] Henk Tolsma, Fred Kappetein, and Hans Hermans, *De Micro De Maat Genomen - Een Beeld Van De Micro-Elektronica En De Maatschappelijke Gevolgen* (Amsterdam: Dienst Wetenschapsvoorlichting bij de Koninklijke Nederlandse Akademie van Wetenschappen, 1979).

existing computer related industries and for companies of any kind, due to the perceived generic nature of the chip. The representation of corporate interests showed itself also in the composition of the Rathenau Committee. The chair Rathenau had been director of the Philips research laboratories (the *Natuurkundig Laboratorium Philips*). The vice-president of those labs, dr. ir. H. Bosma, was also member of the committee. The committee had moreover two professors from the Technical University Eindhoven (*Technische Hogeschool Eindhoven*), traditionally closely linked to research at Philips. One of them was vice-president of the Central Planning Bureau of the Netherlands. The position of Philips in the Netherlands was explictly mentioned in the introductory chapter of the Rathenau Report:

> The Advisory Group considers it, thirdly, as an important fact that the Netherlands is one of the few countries in which a company is established that has a leading international position in the domain of micro-electronics. It will be a matter of drawing a number of positive conclusions from this.[25]

Philips was in those years still seen as one of the main international players in the development of computer technologies. Philips' presence in Eindhoven was therefore an important specific characteristic of the Netherlands. The other two were the high level of scientific and technological education, and its high population density, high level of economic development and its lack of raw materials. The latter characteristics would make micro-electronics such a good choice for the country, since these were perceived as unambiguously positive with respect to the environment:

> Secondly, micro-electronic technology does not burden the environment very strongly, needs only little energy and has no essential problem of raw materials. Due to this, the Netherlands as a densely populated, highly developed country with a lack of raw materials, is particularly suitable as home base for scientific and industrial activity in micro-electronics.[26]

This perspective shaped the emphasis in the report on the economic effects of the large-scale application of micro-electronics. Although automatisation would lead to the loss of jobs (the majority of the Rathenau Committee estimated this loss at about 300,000), the "rejection of the chip" would lead to an even greater decrease of employment. This stance also informed the way the Rathenau Report framed the need for a public debate about micro-electronics.

[25] Rathenau, "Maatschappelijke Gevolgen Van De Micro-Electronica,", p. 8. "Ten derde beschouwt de Adviesgroep als een belangrijk feit dat Nederland een van de weinige landen in Europa is waar een concern gevestigd is dat internationaal een leidende positie heeft op het gebied van de micro-elektronica. Het zal zaak zijn hieruit een aantal positieve conclusies te trekken."

[26] Ibid. "In de tweede plaats is de micro-elektronische technologie weinig belastend voor het milieu, legt slechts een gering beslag op energie en kent geen wezenlijk grondstoffenprobleem, waardoor Nederland als dichtbevolkt, hoogontwikkeld en grondstoffenarm land bij uitstek geschikt is als plaats van vestiging van wetenschappelijke en industriële activiteit op micro-elektronisch terrein."

Framing the public debate in the Rathenau Report

An important motive in the organisation of the public debate according to the Rathenau Report was the prevention of "unnecessary resistance":

> A responsible policy has to have the support of society at large. It should be prevented that arguments and criteria that have broad support in society are being ignored in the policy making process. Policy that lacks sufficient support will trigger resistance that should have been prevented.[27]

According to the Rathenau Report, broad support for technology development and innovation in society should be organised by two different means: the inclusion of all available organisations in the deliberation; and the education of large segments of the population, both with respect to the technical skills and the social consequences of micro-electronics. However, the educators themselves were not deemed to know what the future would be. This is the reason the Rathenau Committee advised the organisation of technology assessment studies. These should play a double role: on the one hand they should systematically explore possible futures, on the other hand they should contribute to the education of the public. The Rathenau Report frames this on the basis of the idea of "interactive mode":

> By this is meant that one has to try to determine which future is desirable and how it can be reached step by step. For this approach a number of building blocks are available:
> - the sense of direction that exists in society, the notion of ideals, of a better world, of decrease of suffering and injustice;
> - a learning function, the possibility to compare concepts and the evaluation and adjustment on the basis of this comparison;
> - systematic and analytical methods for the tackling and solution of problems.[28]

The Rathenau Committee advocated this approach of interactive policy development because it saw this as a means to prevent deadlock in society:

> A strategy like this can prevent that one values extrapolations too much and at the same time that lack of factual data leads to indecisiveness. One also assures that decisions that are taken will fit into one's vision of the future; a future in which much more than only technology is a part.[29]

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[27] Ibid., p. 77. "Een verantwoord beleid dient te steunen op een brede maatschappelijke basis. Voorkomen moet worden dat er argumenten en criteria in het beleidsvormingsproces worden veronachtzaamd, terwijl ze in de samenleving wel opgeld doen; beleid dat op een te smalle basis is gefundeerd roept weerstanden op, die ondervangen hadden moeten worden."

[28] Ibid. "Hiermee wordt bedoeld dat getracht moet worden vast te stellen welke toestand de gewenste is en hoe deze stap voor stap kan worden bereikt. Voor deze benadering zijn een aantal bouwstenen beschikbaar:
het richtingsgevoel dat in de samenleving bestaat, de notie van idealen, van een betere wereld, van vermindering van lijden en onrecht; een leerfunctie, de mogelijkheid tot vergelijking van denkbeelden en het op grond hiervan kunnen evalueren en bijsturen; systematische en analytische methoden tot het aanpakken en oplossen van problemen."

[29] Ibid. "Een dergelijke strategie kan voorkómen dat men aan extrapolaties een al te grote waarde hecht en tevens dat gebrek aan feitenmateriaal tot besluiteloosheid leidt. Men bereikt er ook mee, dat nu genomen besluiten in de visie op de toekomst passen, een visie, waarin veel meer dan de technologie is opgenomen."

This was seen as especially important in the case of micro-electronics due to the dearth of solid facts about the impact of the computer on society. The Rathenau Report repeatedly stressed that there was not enough known to already take definitive decisions in technology policy. This was an important motive to try to keep all options open, while proposing a policy development that was essentially cyclical and in which the outcomes would lead to permanent reformulations of the policy goals. The generic nature of information technology was also seen as a reason for interactive policy development. The public debate played in the view of the Rathenau Committee an important role as carrier of this cyclical policy development.

> Decisions now should not hinder debates in broad circles; on the other hand, the debate should not impede the taking of necessary measures now.[30]

Organising the public debate was not merely seen as a matter of public relations, but even more as a matter of education. The creation of trust relationships was seen as essential:

> It is a matter of paying all attention to the creation of such a basis for trust that a real cooperation to and readiness for social change is created among the population. Such a trust relationship can only be created if the policy process itself is subject to democratic control and on the basis of solid public information, such that the parties involved can participate to the discussion on the basis of knowledge.[31]

The advisory group stressed that this was also the reason that all technology assessment studies should be carried out as openly as possible and should contribute to informing the public. An informed public was in the best position to generate trust in the authorities:

> If every interested person had access to the facts and could form an opinion about these, the fear of a game behind the scenes can be prevented. It is important that active cooperation can be created by trust.[32]

To sum up, the ideas of the Rathenau Advisory Group regarding the organisation of public debate about micro-electronics shows an interesting mix of different modes of public understanding of science. The corporate perspective is present in the urgent feeling that important economic issues were at stake and in the idea that the presence of Philips in the Netherlands should be exploited (both in the benefit of Philips and of the Netherlands). Public understanding as education and public relations is also an important motive. The report saw the development of education as a high priority, both for building up a skilled labour force at all levels of expertise and as a basis for the creation of a well-informed citizenship that was able to insulate itself against

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[30] Ibid. “Beslissingen-nu mogen discussies-in-brede-kring niet in de weg staan; daarentegen mag ook de discussie het nemen van noodzakelijke maatregelen-nú niet belemmeren.”

[31] Ibid., p. 78. “Het is zaak alle aandacht te besteden aan het scheppen van een zodanige vertrouwensbasis, dat een reële medewerking en bereidheid om maatschappelijke veranderingen te dragen bij de bevolking ontstaat. Zulk een vertrouwensbasis kan slechts tot stand komen als de beleidsvorming zelf openstaat voor democratische controle en als er een degelijke voorlichting bestaat, zodat de betrokkenen op basis van kennis aan de meningsvorming kunnen deelnemen.”

[32] Ibid.“Als elke geïnteresseerde toegang heeft tot de feiten en zich daaromtrent een mening kan vormen, kan met meer succes de vrees voor het spel achter de schermen worden vermeden. Belangrijk is dat actieve medewerking door vertrouwen kan ontstaan.”

irrational fears of the computer and could decide on rational grounds. However, this educational approach was not one-sided, because the policymakers themselves were fundamentally uncertain and could not be otherwise. Informing the public should go hand in hand with informing the policy makers. In this, technology assessment took a central position and was seen as a high priority. Because of this interactive policy development trajectory, the Rathenau Report can be interpreted as a very early proponent of public understanding of science and technology as public engagement with science and technology.

The failure and the success of the Rathenau Report

The main message of the report as it was picked up in the news media was that the future was uncertain. Micro-electronics would revolutionise society, but in which way and to what extent was unclear. “Hope and fear alternate, both can be supported with arguments, but these are necessarily speculative. The only certainty is: uncertainty”, the report stated in its third chapter, which was repeatedly quoted in other books and news stories. To sum up the main elements of its advise as it was represented in the media, the Advisory Group proposed that its work would continue in another form, and that multidisciplinary technology assessment studies would be undertaken on a fairly large scale under the supervision of the Scientific Council for Government Policy, and with an aim to inform the public. It also proposed the creation of one national micro-electronics centre of about 20 researchers that should function as a knowledge repository about micro-electronics and as an advisory centre for small and medium-sized enterprises. The Dutch government should moreover support specialisation in software and develop a targeted innovation policy. In this framework, more studies of the impact of the computer on employability and on the distribution of labour in society were proposed. The report also proposed reforming education and the creation of micro-electronics courses at all levels. The report urged the government to quickly develop a policy with regard to the protection of privacy, about which another governmental committee (the *Staatscommissie Koopmans*) had advised. In its last recommendation the report repeated the need for public information about new technological developments in general, and micro-electronics in particular, in order to broaden the support for governmental policy. The government sent the Rathenau Report a few days later to parliament with the promise that it would formulate its standpoint in the Spring of 1980.

It took much longer. The government published its proposals only in early September 1980. In general terms, the government endorsed the report. It made 82 million Dutch guilders available for stimulation of micro-electronics and for research into its consequences. It proposed the creation of an advisory centre for small and medium-sized companies, so that the private sector would be better equiped to use the business opportunities of micro-electronics. Contrary to the Rathenau Report proposals, however, this centre would not be given the task to design micro-electronics and develop applications. The government installed a working group of experts that should give advice on the possibilities for micro-electronics applications. According to the government, the attitude with respect to micro-electronics was important. It should not in the first place be seen as a threat, but more as “a stimulating challenge” that may give many new perspectives for society. It also underlined the uncertainties by stressing that the matter was too complex to already take definitive decisions. Its proposals should be seen more as the beginning of a “process of permanent

reflection". Within the budget of the ministry of science policy, 1.5 to 2 million guilders was made available for research into the social and cultural aspects of micro-electronic technology.

In May 1981, parliament discussed the government proposals and the Rathenau Report. In this debate, minister Van Trier surprised the members of parliament with the sudden proposal to create not 1 but 3 centres of micro-electronics, each one related to one of the three technical universities. In this debate, the disappointment about the government proposals came to the fore. In a reaction to the debate, Rathenau said that he was "greatly disappointed" about the earlier proposals of the government. In his opinion, a strong national centre of micro-electronics that would be the centre of new applications and technology design was absolutely essential. Although the new proposal to create 3 centres did open the door a bit for design functions, he did not agree with the last proposal either. There were simply not enough computer and technical experts in the Netherlands to staff these centres.

> "The making of chips is in itself already very difficult. It seems especially difficult to me to try to do this in three different places in the country, not only with respect to the money involved, but also because of the very limited number of people who have the necessary skills."[33]

Rathenau also stressed that the 10 million guilders the government wished to spend on the three centres was by far not enough. Rathenau was not the only one disappointed. Another member of his advisory group, Bosman, told the university newspaper a few months before that the government had actually not understood the report:

> "Now and then I got the idea that the government had actually not understood the report as such."[34]

His critique was aimed at the lack of sufficient funding of the proposed centre and of adequate measures with respect to the educational system. He regretted in particular that the Dutch government had responded negatively to the basic line of reasoning in the Rathenau Report, according to which the introduction of micro-electronics in the Netherlands could not be left to the market economy but should be guided by governmental policies:

> "They did not understand the essence of the report, or were not willing to understand it. The government has an enormous influence on all sorts of social domains. Why are they so reluctant precisely in this area?"[35]

In July that year, minister Van Trier installed a working group that should advise on the creation of the micro-electronics centre. He opposed a parliamentary motion that proposed to link a working group on technology assessment to such a centre. He also

[33] "Het ontwerpen van chips is op zichzelf al zeer moeilijk. Om dit dan in een klein land als het onze op drie plaatsen te gaan doen, lijkt mij helemaal moeilijk, niet alleen met het oog op het beschikbare geld, maar ook gezien het zeer beperkte aantal mensen, dat voor dit werk geschikt is." Regering kiest nu voor drie centra voor micro-elektronica, Het Financieele Dagblad 2/5/1981.
[34] "Af en toe kreeg ik het idee dat de regering het hele rapport niet begrepen heeft." UK, 10/30/1980
[35] "Dan hebben ze het hele plan niet begrepen of niet willen begrijpen. De regering heeft op allerlei terreinen enorm veel invloed. Waarom dan precies hier zo terughoudend?" UK, 10/30/1980

wished to keep another working group on software development separate from the proposed centre. In September he got the green light from parliament to proceed with the three centres of micro-electronics.

To sum up, most recommendations in the Rathenau Report were only partly taken up in new policies. Instead of the pro-active creation of new computer applications and the organisation of large-scale technology assessment studies, a half-hearted policy was adopted, characterised by infights between different ministries, insufficient funding and instrumentation of the proposed centres of micro-electronics (as perceived by the actors themselves), and delays with respect to the setting up of technology assessment and the orchestration of the public debate.

In Summer 1981, the working group on technology assessment was still not created. The RAWB repeatedly criticised the government for failing to act timely on the advice of the Rathenau Report. A number of additional committees and reports were commissioned, which basically came to the same conclusions the Rathenau Committee had reached, such as the Working Group Micro-electronics in 1982[36]. Some of these reports, like two reports in 1982 by the Council for the Labour Market[37] and the Institute for Social Policy Analysis[38], filled in details that the Rathenau Report had left out. The Foundation Future Vision of Technology[39] organised a large-scale project about the future development of information technology, which nearly broke down because of its complexity. This project had begun in 1978 and was published in 1981. The project explored the impact of micro-electronics on ten different economic sectors and reported the results of 13 different working groups. The president of the foundation told the reporters at the presentation of the results, that it had been the most ambitious project the foundation had undertaken so far[40]. There was certainly no lack of public interest in the new technologies, nor a dearth of reports and symposia. Nevertheless, government action was not experienced as adequate. Perhaps the most telling witness to this feeling of disappointment, is the speech by the highest government official in science policy at the occasion of the opening of Centre of Submicron Technology in Delft in December 1982:

> If we make up a balance anno 1982, where do we stand with respect to micro-electronics in our country? We have to state that not only the preparation but also the implementation has been an uphill battle. In my opinion this is largely due to the fact that the Dutch government does not have much feeling for long term scientific developments. (...) In fact, science and technology do not appeal very much in our society. (...) As said, a forceful policy with regard to micro-electronics has not gotten off the ground. And yet, such a forceful policy is necessary.[41]

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[36] "Werkgroep Micro-elektronica in rapport: Belangrijke kansen op wereldmarkt voor micro-elektronica produkten", Nederlandse Staatscourant, 5 February 1982.
[37] Raad voor de Arbeidsmarkt.
[38] Instituut voor Sociaal Beleidsonderzoek.
[39] Stichting Toekomstbeeld der Techniek.
[40] "Micro-elektronica kan leiden tot toename van informatieverloedering", Trouw, 4 September 1981.
[41] "Als we anno 1982 een tussenbalans opmaken, waar staan we dan met de micro-el in ons land? Geconstateerd moet worden dat niet alleen de voorbereiding moeizaam is geweest, maar ook de uitwerking. Naar mijn mening komt dit voor een belangrijk deel doordat de NL overheid weinig feeling heeft voor en weinig ervaring heeft met langere-termijn wet ontwikkelingen (..). Eigenlijk zou ik nog verder willen gaan en zeggen dat wetenschap en technologie niet leven in onze samenleving. (...) Zoals

It would nevertheless take five more years before the Dutch institute of technology assessment NOTA[42] would be created. And this can, after all, be interpreted as a delayed victory of the Rathenau Advisory Group.

The chip as the main concern

It is worth noting that the issue as discussed was "the impact of the chip". Micro-electronics was the main term. Only during 1983 do we see a gradual displacement of this technology oriented terminology by a more generic conceptualisation of "information technology and information policy". The debate was strongly oriented to a conceptual framework in which technology was seen as having an impact on economic, social and cultural relationships. The books and publications are witness to a certain bewilderment of the authors regarding the new technology. The chip was a very strange phemenon, it was put in brackets: the "chip"; and it was explained with diagrams, electrical circuits and the visualisation of Boolean logics. In this respect, the Rathenau Report was certainly not unique. The difference between analogue and digital technologies was an intriguing issue. This attention to the technical specificities of digital technologies should be understood against the background that the European computer industries of the time mainly focused on the development of analogue computer technologies, in contrast to the US-based industry which had put its cards on digital electrical circuits. Perhaps a telling detail is that the Rathenau Commitee explicitly thanked the Technical University of Eindhoven for the use of its word processor, developed by the EB department, in the production of its report. Word processors were the new new thing of those years, as were chess computers ("playing chess against an electronic box"[43]).

Conclusions and reflections

It will by now be clear that the Dutch state did not organise a focused official public debate about the future and impact of information technologies, in contrast to its decisions with respect to nuclear energy. Rather, the Rathenau Report was a consequence of an already ongoing debate and it became an element of that debate. In Dutch society, like in other European countries at that time, there was considerable amount of enthusiasm about and playing with computers. There were also high expectations of the impact of the computer on the organisation of labour and on the prospect of different economic sectors. At the same time, the impact on employability seemed mainly negative and the trade unions were generally pessimistic about the impact on the quality of labour. There were also concerns regarding the protection of privacy, an issue which had developed independent of the debate about micro-electronics.

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gezegd, een krachtig micro-elbeleid is tot nu toe niet van de grond gekomen. Toch is zo'n krachtig beleid mijns inziens noodzakelijk." Nederlandse Staatscourant, 9 December 1982.

[42] Nederlandse Organisatie voor Technologisch Aspectenonderzoek.
[43] Tolsma, Kappetein, and Hermans, *De Micro De Maat Genomen - Een Beeld Van De Micro-Elektronica En De Maatschappelijke Gevolgen* p. 52. "Toepassing in de consumentensfeer: schaken tegen een elektronisch doosje."

The Rathenau Report did not take a strong stance on these issues, but restricted itself more to a plea for a policy that was open to these concerns. In this way, it gave a central place to the public debate in policy development. In practice, however, it is doubtful to what extent these considerations have effectively changed policy practice in the Netherlands. As we have seen, even the most central of policy makers in this area did not look at the actions by the Dutch government with much approval.

The public debate did not develop into the grand discourse about the future of Dutch society that Rathenau had envisioned. Instead, the discussion over the next few years developed mainly among experts, most of them related to interested parties. This debate did however take place in the public domain and the media. Therefore, it deviates from the usual technology policy development which can be characterised as discretionary governance . The development of the debate in the Netherlands can probably be characterised as dominated by a mixture of corporatist and educational governance. Hints of deliberative governance and agonistic governance may be present in the form of trade unions and womens lib organisations asking fundamental questions about the role of automation and computer technologies, but these seem not to have shaped the core of the debate agenda and the dynamics of the debate in any strong sense.

As far as the available documents show, the debate took place in the form of conferences hosted by industry associations; seminars and study meetings organised by political parties and academic researchers; and publications and books aimed at increasing public knowledge about the impact of micro-electronics. The last form is probably the most important one. If this is the case indeed, the debate might best be characterised as mainly educationally oriented. Consumers were not present in this debate. The existing hobby computer clubs seem to have focused mainly on hands-on development of computer software and expertise. Producers of computer technologies were present, but mainly by lobbying for specific governmental actions in technology policy, such as on the organisation of the micro-electronics centres, its relation with industry and the role of technical universities.

The debate about the “chip revolution” in the early 1980s can therefore best be characterised as a mix of educational and corporatist Public Understanding of Science. The plea in the Rathenau Report for a Public Engagement of Science would only later be realised by the Dutch technology assessment organisation NOTA.

Rathenau Report: a chronology

22 December 1978: the Advisory Group Societal Consequences of Micro-electronics[44] is installed by Ministerial Decree. Chair is prof. dr. G.W. Rathenau. The committee has 10 members, and two "observing members" from the Ministry of Science Policy.

5 November 1979: Rathenau sends his report to the government with the request to publish it quickly

30 November 1979: the Rathenau Report is published as booklet, titled *Societal Consequences of Micro-electronics. Report of the Advisory Group Micro-Electronics*[45]

16 September 1980 (The Third Tuesday of September): together with the yearly reports on the nation's budget, the government publishes its standpoint with respect to the Rathenau Report. At the same time, it sends the report *Governmental Policy on Information: an explorative study*[46] to parliament. It installs an interdepartmental policy group on information policy[47] with E. van Spiegel as chair. It reserves 82 million guilders for implementation of the advice of the Rathenau Committee.

2 February 1981 and 9 March 1981: Debates about government's standpoint on the Rathenau Report in the Standing Committee on Science Policy of the Second Chamber of Dutch parliament.

30 March 1981: Minister Van Trier (Science Policy) sends a letter to parliament with his plan to create micro-electronics centres in Delft, Eindhoven and Enschede.

4 April 1981: Minister Albeda (Social Affairs) commisions a follow-up study on those social consequences of micro-electronics to Metra Consulting (London).

7 May 1981: Minister Van Trier installs a Working Group that should advise on the realisation of the three micro-electronics centres. Van Trier requests the group to come with their advise

21 May 1981: The Centre for Information Policy[48] publishes a report *The Netherlands in the Information Age, a framework for the discussion about information policy in the Netherlands*[49], written by Arthur D. Little with contribution by Horringa and Koning from Bilthoven, the Netherlands.

3 June 1981: The Advisory Council for Science Policy (RAWB) publishes its year report 1981.

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[44] Adviesgroep Maatschappelijke Gevolgen van de Micro-Elektronica.
[45] Rathenau, "Maatschappelijke Gevolgen Van De Micro-Electronica,".
[46] *Overheidsbeleid op het terrein van de Informatie: een probleemstellende verkenning.*
[47] Beleidsgroep Informatie.
[48] Centrum voor Informatiebeleid (CIB).
[49] *Nederland in het informatietijdperk, een raamwerk voor de discussie over het informatiebeleid in Nederland*.

19 June 1981: The creation of the Foundation Informatics Research (SION)[50] is made public. This foundation is still in the making, finalisation is expected after NWO has decided to include the new foundation in its organisation.

4 September 1981: The Foundation Future of Technology (STT)[51] publishes a large study on the consequences of the introduction of micro-electronics.

16 September 1981: The government publishes it Science Budget, in which the formation of a Working Group on technology assessment is announced.

1 January 1982: TNO, the national network of applied research institutes in the technical sciences, starts up the Centre for Micro-Electronics TNO in Delft.

11 January 1982: Minister Van Trier creates a foresight committee on research into information services.

5 February 1982: The Working Group Micro-Electronics publishes its report.

9 April 1982: Minister Van Kemenade (Education and Science Policy) gets the green light from parliament to create three centres of micro-electronics, on the basis of the report of the Working Group Micro-Electronics.

17 June 1986: The government creates the Netherlands Organisation for Technology Assessment[52].

19 April 1994: NOTA's mission is reformulated and the institution is renamed to the Rathenau Institute.

[50] Stichting Informatica Onderzoek Nederland (Sion).
[51] Stichting Toekomstbeeld der Techniek (STT)
[52] Nederlandse Organisatie voor Technologisch Aspectenonderzoek NOTA.

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