4. Putting it all together: newMetropolis

4.1 newMetropolis: a brief history

newMetropolis has its roots in a small museum dedicated to the theme of Labour. In 1923, Dutch painter Herman Heijenbrock founded the Museum van den Arbeid, dedicated to celebrating the industrial labour shaping the course of the twentieth century. Herman Heijenbrock's (1871 - 1948) career, consisted largely of landscape paintings of dunes, tulip fields, and pastoral villages, until he went to a mining-district in Belgium in 1899. 'In the beginning I was paralysed by so much misery, but gradually I realised what a great thought bound together the labour of thousands of people, whose names no-one knows, whose lives slide into the monotonous rhythm of duty. (...) Industry had got hold of me, she did not let go of me, and for years I have sought the subjects for my work in factories and workshops.' From that time onwards, painting pictures alone did not satisfy Heijenbrock anymore. He wanted to know exactly how everything worked together, and started to collect tools and products from the workshops, often taking samples home for closer inspection.

Heijenbrock's collection grew fast, and in 1922 he held his first exhibition at the Stedelijk Museum in Amsterdam, under the banner 'the animal as raw material for industry'. Part of the exhibition featured his own paintings, and a selection from his collection of tools, products and raw materials. A year later Heijenbrock put his entire collection on display in the attic of the Veiligheidsmuseum [Industrial Safety Museum] in Amsterdam, and the association 'Het Museum van den Arbeid' [the Museum of Labour] was founded. For financial support, the Association turned both to the government and to its own members, which included leading representatives of Dutch industry.

Soon afterwards, the Association's pleas bore fruit, and it was given an unoccupied school building on the Rozengracht, close to the centre of Amsterdam. On February 2nd, 1929 the Museum van den Arbeid opened its doors to the public. 'The mission of the museum is to raise appreciation for unappreciated labour, done by thousands of nameless people, and to bring this labour to the attention of children and adults, so their understanding of their fellow man will improve, and their love for their fellow man will increase'. In order to achieve this goal, the material in the exhibition 'was arranged in retrospective order ... it starts with the finished product and goes back to the earliest origins, nature (the animal, the plant, the mineral, etc.), as supplier of products for industry.' Heijenbrock had an innovative vision of how information should be communicated, and this fascination with labour was reflected
in his approach, which was unusually advanced for its time: ‘nature, subservient to technology. [...] The cow as supplier of explosives, the mountain as producer of glass.’

The collections grew steadily, and after a few years the Museum contained over 5000 objects divided amongst 27 departments and illustrated with more than 600 paintings and pastels by Heijenbrock himself, and once again it was ready to expand. However, the museum encountered severe financial problems after the war. The industry’s subsidy to the Museum lapsed, and as a consequence the state cancelled its grant in the early fifties as well. Sadly, the collection had become dated and the school building had fallen into disrepair. However, in 1952 the Association decided to ask industry to collaborate with them again, although not without recognising the need for change. Industry renewed its support of the institution, and, after a radical reorganisation of the collections and renovation of the building at the Rozengracht, the Museum re-opened on May 21st, 1954. The new museum was named ‘Nederlands Instituut voor Nijverheid en Techniek’, (NINT) [Dutch Institute for Vocations and Technology]. The bulk of Heijenbrock’s collection disappeared to depots and to other museums, and only about 300 pastel and oil paintings stayed in the NINT. Fortunately, Heijenbrock himself did not live to see the dispersal of the Museum van den Arbeid – he died in 1948.

The mission of the new institution was to ‘increase attention for industry and labour and related issues in the broadest sense, especially to help vocational choices and education.’ In the new institution the representation of Dutch industry was given more attention, and exhibitions were divided mainly according to profession until well into the 1970s. A leaflet from 1960 describes the NINT as ‘the connection between youth and industry’. Exhibitions were about oil, metal, electronics, glass and ceramics, and textile and clothing. The NINT wanted to ‘facilitate vocational choices. It shows the new generation what labour they can expect in the different branches of industry.’ Later exhibitions were about the atom, telecommunication, energy, the weather, video, and synthetic materials.

In 1979 the mission was given a ‘modern interpretation’. ‘The objective is to excite interest in the basic principles of the natural sciences and the technological applications, and to make clear the role that people play in it, [especially] by giving information about professions.’ In recognition of this new direction, in 1980 the Director of the NINT and the Head of Education visited science centres in the United States and Canada, but returned with an equivocal outlook ‘We are aware that a
science centre similar to those in the United States is not feasible for a relatively small country like the Netherlands. But we do strongly believe that a national technical museum, where, apart from modern technology, the historical development of science and industry is shown, is possible.

Several years passed since the study tour of North American science centres, but the idea of a science centre was not to completely disappear. In 1988 a feasibility study was commissioned by the City of Amsterdam, and conducted by the Ontario Science Centre in Toronto, for a proposal called the ‘Ypsilon Science Center Amsterdam’. As a first priority, the feasibility study outlined the necessity of finding a ‘director of the centre [...] who possessed the necessary involvement and vision.’ The advice was taken seriously. During that year major organisational changes took place in the NINT, both in the staff and the board. In late 1988, Joost Douma became the new director of the NINT. Soon afterwards the Science Centre project was included in the ‘Notice of points of departure for the development of the IJ-banks’ of the city council, and located on top of the IJ-tunnel. By 1990 the NINT had received financial promises from the city council of Amsterdam and statements of commitment from leading Dutch Industries. In this context, a beginning was made to renew the NINT’s collections, in order to serve as ‘pilot-projects’ for Ypsilon. In 1990 the NINT’s permanent exhibition was renewed entirely. Amongst other changes, there was an ‘Exploratorium’ where visitors could use ‘hands-on’ exhibits inspired by the world-renowned San Francisco Exploratorium to playfully discover aspects of the forces and phenomena of nature.

In 1991, partly as a consequence of the urging of Foundation for Public Information on Science, Technology and the Humanities [Stichting voor Publieksvoorlichting over Wetenschap en Techniek – the PWT], the ministries of Economic Affairs and of Education and Science committed themselves to provide substantial financial support to the science centre project, on the condition that Dutch Industry would also provide a major contribution. The intensive fundraising by the Director and his Associate that followed proved a success, despite a difficult economic climate. Many major Dutch companies were convinced by the government’s willingness to subsidise the building and the infrastructure.

In 1992 the Italian architect Renzo Piano was selected to develop the building design, based on the preliminary programme of requirements defined by the 1988 feasibility study by Moriyama and Associates. Renzo Piano had already built an international reputation for public projects, which included the Centre Pompidou in Paris,
the De Mesnil Gallery in Houston, and the new Kansai airport in Osaka. By the time the science centre was underway (1993), Piano was selected to oversee the reconstruction and redevelopment of the Potsdamer Platz in Berlin, and he has since then won the Erasmus Prize for humanism (1994) and architecture's highest honour, the Pritzker Prize (1997).

In early 1994, while the building development was already in process, NINT director Joost Douma wrote 'Prototyping for the 21st Century - a discourse' [hereafter referred to as the 'Discourse'], as a consequence of the ideas he had been developing for the project, influenced in part by papers written by the author. In the preface he states: 'The reason for writing it has been primarily to develop a vision to guide our development. For we truly believe that we cannot simply build a Science Centre without having reflected as thoroughly as possible on what role this new centre should and could play in our present and future society. Science centres and museums alike have always been children of their time and this infant of ours should be able to participate in societal life for as long as possible.'

In his Discourse Joost Douma, positioned the new institution in its historical context, and in the context of the socio-economical culture of the decades to come. By analysing the relevant issues of the near future, and by looking back at the development of science museums and centres, he concludes that science centres should be considered as independent agents, with their own role to play in society, as opposed to merely serving scientists, formal educators, politicians, technicians, and industrialists.

Until the writing of the Discourse, the development of the NINT's new exhibitions and those intended for the new institution had followed the conventional trajectory of most similar projects. The programme of requirements for the building had been developed (largely without any consideration of future exhibitions), and the gross area of public exhibition space provisionally determined. Key industry sponsors had been identified and approached. Specialists from around the world had been consulted and exhibition themes discussed at length, and five over-arching themes selected. Staffing needs had been identified and an active programme to recruit young Dutch talent had begun. Nevertheless, despite this activity, the project still lacked a clear vision - a sense of what would render the project consistent, coherent, and set it aside for the countless science centre projects in Europe and North America undertaken during the past two decades. The Discourse was the first step.
in transforming the project from an urban renewal project with a building as its centrepiece, into a project to create the prototype for a totally new kind of institution of informal learning.

The Discourse begins by looking at the changing world, and the importance of new skills to meet the challenges of a changing world. In common with its predecessors the Museum van de Arbeid and the NINT, newMetropolis had as a central concern the changing nature of work, and the importance of preparing a new generation to meet new challenges in the workplace. Douma writes ‘It is acknowledged that we are rapidly moving from an era of high-volume production to one of high-value tailor-made production ... It is recognised that the once-mighty multi-nationals no longer produce growth in employment or profit, and are breaking up into semi-independent international networks, requiring new skills of their workforce – skills on which science centres have already been focusing for many years.’

4.2 From Discourse to design strategy

By December 1994 newMetropolis had come to a major turning point. The science centre had been in the planning stage for over two years, during which time the staff explored a variety of strategies and a series of approaches to design and public education. Some of these explorations had enjoyed a limited success, while others had not fulfilled their promise. Throughout 1994 there was uncertainty about which direction to take, and which exhibition tradition to follow. Early in 1994 the Director had even considered confiding the design of the exhibitions to the San Francisco Exploratorium – pioneer in the development of ‘hands-on’ exhibitions.

Peter Anderson, then Head of Exhibit Development, formerly with the Chicago Museum of Science and Industry, was publicly voicing the need for a unified approach to the design, something he felt he could not provide. It was clear at that point that newMetropolis had most of the elements required to create a science centre that lived up to the ambitions of the Director – an inexperienced but creative staff, and a written mandate to create a new kind of institution in the form of the Discourse. What was needed was a bridge – a theoretical approach that would allow the project to move from the vision outlined in the Discourse into a realisable exhibition strategy. What exactly was a ‘third generation’ science centre? Or even more challenging, what was a ‘fourth generation’ science centre? The Director knew he wanted one – but was unable to say what it was. The author was approached by the Director in July 1994, during the final months of the Mine Games exhibition.
The author joined the project in November 1994, and saw in the project the possibility to continue experimenting with the new ways to move the locus of informal learning away from the specialist and towards the user that had marked his past work with Drew Ann Wake, an ambition fully consonant with the goals defined by Douma for newMetropolis.

The author successfully secured the Director's assurance that he had the authority to restructure the design process, dismantle the existing department structure, and reconfigure the creative staff in six design teams – one team for each of the thematic zones plus a team for live programming. As a means to achieve the challenges outlined in the Discourse, he prepared a document to be used by the design teams as a kind of a 'manifesto' for designing a 'prototype for the 21st century'. This manifesto took a critical look at the history of the institution during the past three decades, and positioned the new institution as the consequence of having learned from past failures.

The Discourse raised some of the following questions: 'What sort of world can we expect in the next century?' To this the author added the following concerns: 'what will the next generation demand of our institutions of informal education? With a computer, a modem, and an interactive television in every home, and commerce catering to the growing need for more games, CD-ROMs and interactive videos, what role can the science centre play in the life of the 21st century family? 'More importantly, what did this mean in exhibition design terms?'

To answer this question, the author first looked critically at the history of the science centre as an institution of the 20th century. In responding to the science centre tradition, he challenged (sometimes rhetorically) several common assumptions about science and technology, its audience, and the exhibition strategy that has followed from them. As a starting point for the arguments that were to be at the heart of the exhibition design approach, newMetropolis was placed in the context of traditional science centres and the assumptions they are often based on. In order to understand the design of the institution and its exhibitions, the author's document - the 'Manifesto' – is quoted from at some length below: This document, written in December 1994, also serves to underline the extent to which the design of newMetropolis's exhibitions was the consequence of an explicit discussion and debate.

The North American experience seems to show that attendance to individual science centres is going down, despite the fact that nearly every major city now has a science
centre. The downward trend is due in part to general factors, such as suburbanisation. However, one of the key reasons may be that increasingly informal educational opportunities are available at home. With the widespread penetration of computers and computer games, the meteoric rise of use of the Internet, and the prospect of genuine interactive television available in the very near future, there is a diminishing incentive to go to the science centre.

The downward trend identified by ASTC is exacerbated by institutions who see themselves as teaching aids to broadcast scientific principles, and by isolated exhibits designed for the single user. The relevance of the science centre has been called into question, and the preoccupation with individual exhibits and open plan floorspace has led to what is called ‘pinball’ behaviour in many science centres. Now that the novelty of hands-on has worn off, the North American science centre, in its present form, may soon be fighting for its life – or at least for its visitors.

The ‘Traditional’ Science Centre
Since the Exploratorium was planned in the late 1960s, science centres have established themselves as independent institutions of informal education – institutions in which learning is visitor-directed, unforced and untested. “Nobody ever failed a museum” said Frank Oppenheimer when championing the Exploratorium as a real alternative to the curriculum-driven formal school system. Despite this, the science centre continues to be shaped by debates in which certain terms are placed in opposition. Thus education is often put at one extreme of the spectrum, entertainment at the other. The cognitive is placed in opposition to the affective, the rational to the emotional. These oppositions have coloured the way in which science centres have been planned, designed, and realised, and have created what we could call the ‘traditional’ hands-on science centre. Moreover, the perceived tension between these poles has deeply influenced the way in which the words ‘learning’ and ‘education’ are used in the science centre community, and made many science centre professionals nervous about using them at all.

With over twenty five years of experience, we can honestly say the success of the traditional science centre has been mixed. We can identify several obstacles to complete success.

THE MYTH OF THE SINGLE VISITOR. Exhibits are designed as stand-alone elements, each one demonstrating an isolated scientific principle or phenomenon, each one meant to work best with a single visitor. They are often discrete activities, with little oppor-
tunity for visitors to share ideas or exchange information. Interactive exhibits are often designed to accommodate a single user, and often make it difficult for other users to participate. Linkages between exhibits, when they are made at all, are often made by placing exhibits side-by-side, or putting them in groups, without deeper considering the need to link their content, strategy, or visitor activities.

THE MYTH OF PURE SCIENCE. Many museum professionals believe that the role of a science museum is to teach scientific facts – for example, that water boils at 100 degrees. These science centres often shy away from subjects the public finds interesting, including issues in which the science and technology are mixed with social, political and moral elements. They fear that science will lose its authority, and the science centre its claims to be a purveyor of the truth if it opens the institution to debate and discussion. This unwillingness to start with the concerns of the visitor – which are not always defined in the manner of the ‘pure’ sciences – suggests that the visitor’s concerns are secondary – that he is at best a tabula rasa, at worst, wilfully ignorant.

THE NEED TO BEGUILE. Many science centre designers feel the need to make their subjects more ‘fun’ – by adding gratuitous interaction, by cloaking conventional subjects in the guise of popular culture, by using new technologies for their own sake. Often these strategies are an attempt to remedy the perceived lack of interest in subjects as defined by the scientific or academic community – geology, physics, mathematics etc. – subjects taught at school and defined by teachers. This approach betrays a fundamental belief that the science centre is school with a sugar coating – its goal to trick the visitor into the distasteful task of learning.

TOP-DOWN LEARNING. In many science and technology exhibitions, exhibits are reminiscent of textbooks. These science centres have created large numbers of ‘hands-on’ exhibits designed to elicit specific phenomena or demonstrate certain well-known principles. However, despite their ‘interactivity’, these exhibits often only show what the designer intended, and resist efforts to do anything else. They have a built-in ‘right’ answer, which, once discovered, exhausts the potential for further visitor interaction. This kind of exhibit mirrors the top-down learning strategy of formal education, and often serves to reinforce the belief that the informal science centre is only a school in disguise.

All these obstacles stem in some part from the assumption that all education is formal, school-based education, and all learning is coercive, top-down learning. The conse-
quence – often an unhappy marriage of formal educational strategies in the informal environment.

The development of a new science centre, particularly one of this size and scope, gave newMetropolis the opportunity to draw together the lessons of the last several years. Clearly, right or wrong, the strategies commonly pursued by traditional science centres are not consistent with the vision expressed in the Discourse, nor with the author's own theoretical stance. What did newMetropolis want to be instead, and what would this mean in terms of an alternative design strategy? At newMetropolis the visitor is considered to be competent and already active in constructing provisional theories about the world, rather than ignorant or innocent, as is often presupposed by many traditional science centres. The following positions were central to newMetropolis design strategy.

Towards the Future
As a way of shaping an institution that will meet the needs of visitors in the next century we must look at the science centre in a new way. First of all, rather than treating the educational and the entertaining, the cognitive and the affective, as mutually exclusive, they should be seen as complementary (an opposition does exist, of course, between formal education, on the one hand, and informal on the other). How can we exploit the specific nature of the science centre as an institution of informal learning, in order to create a prototype for the next century?

The following observations are central to newMetropolis's design strategy:

VISITORS COME IN GROUPS. The single visitor is rare. Our visitors do not often come alone, but in groups – with their families, with their friends, with their schools. They come to explore new material, make mistakes and learn by sharing experiences together. The visitor's enjoyment of an science centre exhibition is in relation to its content. Visitors learn by being together – they learn by chatting, they juggle ideas, images and facts and influence each other's opinions. More than any other single factor, the social dimension of the experience gives it its emotional charge. The social is emotional, and some of the 'fun' we want to find in our science centres is the same social enjoyment we associate with other group activities such as going out to sports, cinema, and concerts.

SCIENCE IS MESSY LIKE CULTURE. Science is never pure. Science is not merely a series of facts, but a set of ideas, activities and skills in which many competences are
called into play. People rarely relate to science in the same way as the trained scientist, separated from the rest of the world. Instead they see science and technology as intrinsic parts of broader social, political and ethical issues. These issues touch their own lives, the lives of their families, and the world around them. By taking as a starting the real interests of visitors, the science centre can play a central role as a forum for the discussion of science and technology. It can provide information, an opportunity to learn new skills, and a place to discuss the impact of science and technology in our lives and the lives of our children.

THE REAL IS RADICAL. Real science is not school science. Doing science is an intrinsically rewarding activity, and inspires some to take up careers in science. By taking as a starting point the real enjoyment working scientists get from science, exhibits are more likely to be convincing and enjoyable. The visitor should find in the science centre the same pleasure the scientists experiences in doing science – defining problems, testing hypotheses, finding provisional solutions. Only by letting visitors explore the pleasures of real science will they be able to make choices about the role science plays in society – and the role they might play in science.

BOTTOM-UP EXPLORATION. Our visitors are competent. They are already experts in some things, and they often know more than they know how to say. Visitors create their own understanding, and the science centre gives them opportunities to create new knowledge during and after their visit. We cannot always insist on the specific new knowledge they create, as we can in the school classroom. The role of the science centre is to create an environment where the visitor can explore the ways in which he can actively modify his relationship with science and technology. In the science centre, the visitor is in control, and the visitor charts his own course – learning is bottom-up.

Having defined the design strategy in these terms, it was now possible to speak of what kind of institution newMetropolis could become. The institutional strategy of newMetropolis, following from the views expressed above, and the objectives expressed in the Discourse, was defined as follows:

BE AN OPEN HOUSE. newMetropolis must meet the needs of visitors of all ages and interests. newMetropolis must be a welcoming, inviting place; a place where visitors feel at ease. Exhibits and programmes should be interactive, engaging and exciting. newMetropolis’s total attendance should grow to one million visitors over the course of the first few years of its operation. At the same time, exhibits should stimulate the
participation of families in the Netherlands - a significant percentage of visitors. Finally, newMetropolis will draw teenagers and high school students who are at an age to decide whether or not they will opt for a career in science or technology.

BE A FORUM. newMetropolis will be a social forum – the piazza of the 21st century. It is a place where science, technology and culture meet and interpenetrate. newMetropolis must not shy away from issues in science and technology. Rather, newMetropolis should be in the centre of these discussions, as a meeting place and information centre where the people can go to obtain reliable information and explore new ideas and new possibilities. newMetropolis is a social agent, a place devoted to giving visitors the opportunity to be actors in the worlds they choose to explore.

ENHANCE COMPETENCE. newMetropolis is an institution of non-formal education, with a deep commitment to lifelong learning, and it is at newMetropolis that visitors will explore the variety of new skills needed for a rapidly changing world. At newMetropolis, the visitor is in control. newMetropolis will develop new approaches to hands-on learning, approaches that will encourage visitors to become generators as well as recipients of scientific thinking. New approaches to exhibit design will introduce visitors to the skills of abstraction, systems thinking, collaboration and experimentation. These new approaches will become part of newMetropolis's unique contribution to the international science centre community.

THINK GLOBAL, ACT LOCAL. In the 21st century it will not be enough to be a national institution with a beautiful building and attractive exhibits. The science centre must also participate in the global realtime networks that already link universities, governments and industries. By providing information, creating a place for discussion, and developing science centre activities using global information networks, newMetropolis will play an active role as Europe's first 'virtual' science centre.

The goals set out above (be an open house, a forum, enhance competence and think global, act local) were then translated into specific challenges and accompanying objectives in terms of the audience strategy, design strategy, exhibition strategy, and development strategy. These objectives set forth the criteria by which the success of newMetropolis and its exhibitions can be measured. For instance, a key objective was to transform visitors into users:

Objective: Encourage repeat visits – turn visitors into users. The work of educator Marion Martinello suggests that science learning is enhanced by frequent visits to a
science centre over an extended period of time, rather than sporadic visits. Therefore, as a matter of planning strategy, visitors should be encouraged to attend often.

With respect to the audience strategy, over the past years, the NINT had developed an enthusiastic base audience. However, newMetropolis's success depended on being the destination of choice for a wide variety of different audiences. newMetropolis could now develop some targets for reaching new audiences and stimulating new kinds of participation. These objectives were formulated explicitly and communicated to the entire creative staff, and spelled out a commitment to a new approach to exhibition design, consonant with the author's theories. For instance, systems thinking was identified as a key skill users would need in order to meet the challenges of the next century.

Objective: Develop exhibits that encourage systems thinking. Most visitors are part of dynamic systems in their daily lives - every time they are caught in a traffic jam, every time they exchange money or buy a dress, every time they make a date. However, only rarely do visitors have a chance to explore the properties of dynamic systems for themselves – manipulate variable flows, provoke chaotic collapse, increase and decrease bandwidths.

newMetropolis should develop certain exhibits that encourage systems thinking. These exhibits could be based in phenomena the visitor is already familiar with, such as traffic, telecommunications, and the marketplace. The exhibits should allow the visitor to explore the many ways in which dynamic systems behave, and to create interactive dynamic systems for themselves.

An audience strategy cannot be built without a corresponding exhibition strategy. newMetropolis exhibits are intended to be supports for visitor interaction, and their success will be measured by the degree to which they create opportunities for users to interact. Thus at newMetropolis there will be a variety of exhibits to meet the needs of visitors of different ages, interests and learning styles.

Objective: Create a forum for debate. The design of newMetropolis's exhibition zones represents a break with the traditional approach of using isolated exhibits to communicate the laws of science. In contrast to traditional science centre exhibits, it will be a place where visitors are invited to explore emerging scientific ideas and contrasting views. Science and technology is seen as an ongoing process of debates and challenges, in which the merits of competing ideas, theories, and practices are com-
pared and evaluated. Scientific, technological, economic and moral questions all have their place in newMetropolis.

In order to deliver on the promises made in the author’s Manifesto, newMetropolis had to find a way to create permanent exhibitions designed to be the expression of a single, coherent, innovative vision of what a modern institution of informal learning should be. The building certainly expressed this coherence – it was the challenge of the author and his entire team to create the exhibition that did so as well. The next section describes the way in which the design strategy was implemented in newMetropolis’s exhibitions.  

4.4 Developing the newMetropolis design strategy
Over the years, NINT had experimented with a number of approaches to exhibition design. In the beginning of the 90s the NINT, like most science centres in North America and Europe, had developed a large number of ‘stand alone’ exhibits, each of which exploring a single scientific idea or principle. However, in order to fulfil the promises made in the Discourse and the Manifesto, newMetropolis had to develop new kinds of exhibitions that placed their emphasis on the acquisition of new skills, rather than merely new information. This emphasis forced the design teams to explore how to create exhibits that could be profitably returned to a second, third, and fourth time, exhibits in which a user could become more skilled. Inexorably this meant looking carefully at exhibits which implemented the user-languages of problems and games.

For several years prior to the arrival of the author, newMetropolis had been divided into five thematic zones: Interactions, Technology, Energy, Science, and Humanity. The choice of themes for the five exhibition areas had been determined very early in the planning process, as a consequence of both institutional and sponsor-related concerns. These over-arching themes remained a constant feature throughout the exhibition development, despite of the extensive transformation of the actual content of the thematic zones, and provided a continuity from the initial project to its subsequent realisation. Each zone was intended to allow the visitor to explore the consequences of using specific new skills – skills important for the next century, enumerated in the Discourse as systems thinking, abstraction, experimentation, and collaboration.
The design of the exhibitions at newMetropolis was assigned to six teams (one team for each of the thematic zones, and a team for live programming), all reporting to the author, who was responsible for shaping the direction the strategies took, and ultimately, for the realisation of the built exhibitions that were the consequence of these strategies. Each of the six teams was encouraged to explore different text strategies, different design strategies, and to develop their exhibitions using different user-languages. In addition to the Manifesto, the author proposed several overarching guidelines that applied to the institution as a whole. The most important of these guidelines, detailed in internal documents, were a language strategy, and a physical design strategy.

The language strategy took the form of a two-page set of guidelines that applied to all written material in the public exhibitions at newMetropolis, including directional signage, temporary signage, and exhibit labelling. This strategy was intended to make the institution accessible to the greatest number of users possible, and to provide an incentive for use of other languages than one’s own native tongue. Thus all instructional texts in newMetropolis were to be in four languages, and all interpretive texts in non-translated Dutch and English. Hand-in-hand with the language strategy (which was part of a much broader discussion of educational strategies) went a strategy for the physical design of the exhibitions themselves. In conjunction with Renzo Piano, the author developed a vision for the design ‘language’ of newMetropolis – a vision that gave the exhibitions an overall aesthetic coherence. A design aesthetic had been slowly emerging from the way we had been developing the exhibit concepts themselves – with a large emphasis placed on prototyping and testing exhibit elements with real visitors, conveniently available in the NINT museum beneath the newMetropolis offices. The phrase we coined to describe the vision for the entire physical project, both building and exhibitions, was the ‘Noble Factory’. This meant using real materials, expressing the material honestly, and attention to detail, while keeping the design simple and avoiding styling for its own sake.

This design approach was used as a way of ensuring that the design output of all thirty designers in six design teams remained fundamentally coherent. At the same time, content, fabrication, and architectural issues were also allowed to influence the design, thus making the ‘rules’ less rigid and inflexible. In some cases this gave rise to a certain playfulness, such as in the case of the water exhibit in the zone Energy. Over three metres tall and faceted like a rockface, the waterfall emptied into two long, finger-like basins to create dam building experiences for young children.
hardly an element for a factory! However, fabricated from stainless steel in a Lake District shipyard, and finished by grinding the steel in random swirls, the expressed metal and spectacular reflections kept the exhibit within the language of the ‘noble factory’ aesthetic.

As a consequence of earlier experience, we knew the importance of placing the exhibition’s content in context – especially if the user-languages of problems or games were involved. As early as 1990, Drew Ann Wake and the author had been struck by the work of the English sociologist Brian Wynne, and by his research into situated knowledge, which showed that people often have real scientific knowledge, despite the fact they cannot articulate this knowledge in scientific terms. These findings corroborated the research of psychologists such as Donaldson * and McGarrigle, who had shown that children often understand principles in context (such as the conservation of volume) far earlier than they can understand or express it in abstract terms. People know when they need to know, and learn when they can see why learning means something to them personally. This research led us over the years to develop a global ‘bottom-up’ exhibition strategy for the exhibitions in Alberta (described above) and for Mine Games, in Vancouver.

At newMetropolis we started by putting thematic content in a context we believed would be familiar to most visitors – a context we also hoped would unlock their existing situated knowledge about the world – thus empowering them to tackle the further challenges of exhibition content. This was the context of Work. Thus instead of a zone about systems dynamics (communicating the skills of systems thinking being one of the explicit goals of the design manifesto, and one of the four key skills outlined in the Discourse) we provided the zone Interactions with a game about banking (about exchanging value), a telecommunications game (about exchanging information), and a game about transporting cargo through Europe (about exchanging material). In fact, all three games can be used as examples of different dynamic systems (each one is, in effect, a dynamic system that maximises different properties – equilibrium, flow, capacity), but this is for the visitor to discover later – and was explicitly not taken as a starting point for the exhibitions.

Our desire to situate exhibition content in context had several unexpected but desirable consequences. First of all, as most of the contexts that had meaning to people were related to work and working, this brought the exhibition strategy back to the roots of the institution as the Museum van den Arbeid – the Museum of Labour. Second, from the outset, we had said that we wanted to create an institu-

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* Donaldson, M. Conservation: What is the question? British Journal of Psychology, 73, 199 - 207
...Moreover, as institutions of informal learning are increasingly being asked to catch those who fall out of the formal system, this accent on skills and employability was seen as an important plus to the government ministries who supported the project. Finally, despite the fact that this approach was devised independently on educational grounds, it proved consonant with the fact that 100% of the funding for the exhibition came from the private sector, unique in the world for this type of institution, and the emphasis on working environments allowed us to take advantage of support from industry, with such as a newMetropolis-wide information system (Actua), live demonstrations and street theatre (the Pop-up actors), and educational materials aimed at allowing different levels of the formal education system embed a visit to newMetropolis in an extended ‘learning trajectory’ (the Starter’s Kits). Taken together, the sum of these elements was a new kind of informal learning environment, a coherently developed expression of the theory described in this study.

4.5 newMetropolis: prototyping for the 21st century

Given the large number of exhibits at newMetropolis, it is not possible to describe and evaluate all of them in detail. A complete description of all the exhibitions, supports, programmes, and products developed by newMetropolis for its formal opening June 4th, 1997 (not to mention the ongoing development work conducted during the remainder of 1997 and in early 1998) would tax the endurance of even the most committed reader. Instead, each of the five zones is looked at in terms of a description of selected exhibits, the behaviour these exhibits elicit, and the conclusions we can draw from these observations in terms of the effectiveness of the user-languages employed.

Science:

**USER-LANGUAGE:** variables (individual exhibits/Debate) problems (text panels/Debate) – problems (Lab)

**TEXT STRATEGY:** second-person text non-narrative (Lab) narrative framework (Debate) with historical characters

**TARGET AUDIENCE:** 9 - 12 year-olds
The theme of Science is treated in two separate experiences in newMetropolis, which could be said to constitute two separate 'sub-zones'. These two sub-zones are called 'The Lab', and 'The Debate'.

The Lab is a working laboratory, staffed by trained scientists, and its goal is to allow visitors over 12 years to 'do science'. In the Lab the user-languages of the activities themselves are observation and variables, as these languages characterise the practice of science, but as the onus for questioning is placed on the user, the user-language of problems of the Lab itself is that of problems. The staff scientists (as well as volunteers drawn from the national association for retired chemists) help visitors frame their own questions, and conduct their own experiments, in the manner of Science North, in Sudbury, Ontario. For visitors who are not able to articulate a specific research question, there are a series of pre-prepared experiments which allow the visitor to test various substances, such as the quality of their local water, the composition of their breath etc. – questions that were discovered during prototyping to be of interest to a broad public. There are also regular workshop activities, including a 'Crime-Lab', similar to The Body in the Library, where the visitor uses laboratory experiments and forensic evidence to identify a criminal, as well as workshops to make 'dropjes' (local liquorice confectionery), or analyse the food they eat. The texts and instructions are all presented on worksheets attached to a clipboard, on which the visitor can record their results and compare their findings.

To date, the Lab has proven to be one of the most popular features of newMetropolis. Only 15 visitors can use the Lab at any given time, and there are often waiting lists of several hours. One of the reasons for the Lab's popularity is the user-language of problems, which unlocks the intrinsic delight visitors find in self-directed experimentation and discovery, although it is clear that visitors appreciate and use the pre-prepared experiments to guide their experience. Another reason is the presence of staff in the Lab, who are available to answer questions, explain techniques, guide research, and, in the case of the volunteers from industry, talk about working life in a real Lab.

The second part of the theme Science puts science in the context of a debate about the nature of light. In the past, scientific questions regularly led to conflicts and controversies. One of the topics that was debated for centuries was the nature of light – was light like a wave or like a particle? Many natural philosophers, artists,
intellectuals, physicists, and mathematicians were intensely interested in the question of the cause of seeing, and as a consequence, the nature of light itself. The questions about the nature of light and seeing were raised for various reasons - curiosity, utility, avarice, scientific interest - and even wanting to know because of knowing itself.

In the Debate, a large introductory text panel introduces two characters arguing about the nature of light - is it a wave, or is it a particle? These two characters reappear on the text panels accompanying each of the exhibits. One of the characters is English (recalling Sir Isaac Newton), and argues in heated language that light is a particle phenomenon, the other is Dutch (recalling Newton's older contemporary, Huygens) and argues in equally strong language (albeit in Dutch) that light is a wave phenomenon. By introducing a debate between two natural philosophers, conflict is shown to be an important aspect in the shaping of science. Whatever is taken for 'truth' within the scientific community is determined by groups of scientists arguing, proposing, counter-proposing, and eventually, reaching consensus.\(^9\)

In this area visitors can use several hands-on experiments to build up a case for or against either the faux-Sir Isaac Newton or the faux-Constantin Huygens as to whether light behaves like a wave or a particle. The exhibits themselves are very similar to those found in 'traditional' science centres - a wave table, parabolic mirrors, a bubble sheet, a sodium-slit experiment - albeit in an entirely different context. As in the traditional science centre the user-languages are observation and variables, and the activity is explicitly experimental and comparative. The panels texts are written as an argument between faux-Huygens and faux-Newton, although some historical license is taken regarding the arguments used, given that the real debate lasted over 200 years, and is still going on. The following example of the text gives a taste of the way in which the user encounters the arguments:

RECHTS OF LINKS, GOLF OF DEELTJE?
Whose side are you on?

<table>
<thead>
<tr>
<th>Listen, I cannot see you, but I can hear you!</th>
<th>Het is helemaal niet vreemd dat je me wel hoort maar niet ziet!</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strange. Light doesn't do what sound does. Maybe light only travels in straight lines, like balls do. Light is blocked by a wall - but sound is a wave and goes around things. That's why I can hear you, even when I can't see you!</td>
<td>Geluid is een golf en kan om dingen heen. Nou wil dat niet zeggen dat licht geen golf is. Om licht dan maar gelijk een deeltje te noemen, omdat dat nu eenmaal rechtuit gaat, gaat mij te ver. Licht is alleen een heel klein golfje, dat niet om muurtjes heen kan komen.</td>
</tr>
</tbody>
</table>

\(^9\) There is an extensive literature in the History of Science that documents this process, starting with Kuhn, Popper, and Lakatos, and culminating most recently in Shapin, Schaffer, Latour et al.
This sub-zone has proven to be one of the most difficult for visitors to use. Despite the large explanatory text panels and explicit instructions, visitors find the idea of the area difficult to grasp, and only a few engage with the experiments in the way the designers had hoped. Changes to the instruction texts have reduced the amount of visitor uncertainty about how to conduct the experiments, but visitors still use the exhibits in a way that characterises ‘traditional’ science centres. They play briefly with the phenomena, they explore them more or less chaotically, and if they do start an experiment, they often leave it unfinished. The over-arching question the area poses is difficult for visitors to grasp, and when explained, it is seen to be difficult and abstract. Although for centuries the ‘problem’ of light’s nature taxed some of the world’s finest scientific minds, it just isn’t problematic for most visitors.

One conclusion we can draw from this experience is that despite the fact that in principle, questions are inherently more ‘open’ to visitors than answers, even questions can be ‘top-down’ if they do not respond to the visitor’s interests or background. It appears that as the question of physics is not a burning issue in people’s lives, visitors are not prepared to enter into the debate about physics. Another way to understand the listless behaviour is in terms of the user-languages employed. As the area relies on the user-languages of observation and variables, there is no challenge or outcome that co-ordinates interaction with the stand-alone exhibits, and, as a consequence, visitors frequently fail to engage with the material. While the question of light’s character was and is part of a group of problems for physicists, the exhibition itself does not itself fully exploit the user-language of problems. The user-language of observation confers no agency on the user, and given the remoteness of the issue, the user confers no engagement on the exhibit.

Interestingly, the exhibition is extremely popular with teachers, who substantially augment the user-language of problems by dividing their classes in two, and challenging the students to take sides and argue positions, much in the way the Body in the Library’s Alibi programme had students making arguments for different possible culprits. Staff are currently planning to enhance the area with a regular performance by live actors who take the parts of the two protagonists, and ask visitors to help prove the other wrong. We hope that by augmenting the user-language of problems – contextualising the issue and giving visitors a clear reason to conduct the experiments – this will result in greater visitor participation and longer engagement with the exhibits.
Technology:

USER-LANGUAGE: problems (cluster activities)
    games (Fabriek/Double Wedding/5th Man)

TEXT STRATEGY: second-person text throughout
    - non-narrative with cartoon characters (cluster activities)
    - narrative framework (Fabriek)
    - narrative (Double Wedding/Fifth Man/demonstrations)

TARGET GROUP: 7-10 year-olds

The bulk of thematic zone Technology is built around a series of challenges, articulated by cartoon characters in the second person. The user-language of the Technology zone, like that of Beyond the Naked Eye, is largely that of problems, although as the zone is primarily intended for younger children (7-10), the challenges are less difficult. There are two sets of challenges, one on either side of the exhibition space. On one side the challenges are placed in the context of the human body, on the other, on the automobile. Each set comprises three separate clusters of activities, in which the visitor discovers the ways in which tools can help them increase their precision, in the case of the body, or their strength, in the case of the car.

The three clusters about precision are on three tables. The first challenges children to use different tools to explore the body of a popular Belgian cartoon character, Jerom, from the series 'Suske en Wiske'. The second allows visitors to explore themselves and the world around them by means of lenses, mirrors, microscopes etc. The third table contains a series of case studies and files which allow the visitor to perform simulated operations on a body lying under a piece of surgical cloth, which requires the visitor to reconstruct the workings of the tendons in the hand by reconnecting the bones with the appropriate elastic ‘tendons’ such that the entire hand is once again functional. As an example, the text from this exercise (written in balloons above the heads of two cartoon characters) is given below:

TN13Bd handje

"Handig al die losse stukjes, opereren lijkt net puzzelen, doe je dat botje nu niet ondersteboven?"

"It's amazing how many little bones go together to make the hand work. Can you figure out which piece goes where?"
On the other side, the clusters are grouped in three separate ‘cars’ made of stainless steel. Here the visitor can change a wheel, experiment with different gears, make pistons turn, and adjust valves and knobs to regulate feedback. The text strategy is identical to that described above.

Several remarks can be made about the ways in which visitors use these exhibits.

First of all, the exhibits are popular with the age group for which they were intended. In particular, pre-pubescent girls spend large amounts of time in the zone working on the exhibit challenges. Overall, however, the instructions were inadequate, and were rewritten within weeks of opening to give more explicit guidance to exhibit function. In particular, contrary to our expectations, the cluster of activities in the cars was less successful than expected. When the activities were prototyped in the NINT, with a makeshift car body and constant staff supervision, the challenges of taking off the wheel, changing the tire, and making the engine turn gave rise to an enormous amount of self-directed activity, consistent with what we had hoped would result from the user-language of problems. However, during the design phase, so many possible activities had to be eliminated or constrained in order to make the exhibits safe for an unsupervised public, that the reward for engagement with the activities was drastically reduced, and the scope for the user’s own problems almost completely curtailed.

This reduction of possibilities, and as a consequence, for variety generated by the visitor herself, seems to have had the effect of making the exhibits boring to many users. It is interesting to note that while labels that implement the user-languages of problems and games confer the property of actorship on the user, the threshold for the user conferring the property of engagement on the label is much higher than with other user-languages. In the case of the cars described above (and that of the Debate, described earlier), if the interest or relevance of the problem is reduced, or the reward for playing the game not sufficient, the user-language alone does not ensure that the user will engage with the label.

Second, contrary to our initial expectation, which would have had boys playing primarily with the cars and girls working at the tables (an expectation based on our work in Alberta which suggested that women and girls preferred biological or health-related subject matter), girls seem equally intent on working on the cars
as well. However, consistent with our expectations, there appears to be a clear difference in the ways in which boys and girls use the same exhibits. Boys spend less time with the exhibits, and seem to need immediate feedback, otherwise they tire quickly of the activity and leave. Girls, on the contrary, tend to work in groups, often with one group member reading the instructions and helping the others with the activity. The greater the complexity of the activity, the more it seems to hold girls' attention. This means that the table with the case studies is the most used by groups of girls, and most frustrating for boys. As a consequence, the table needs frequent repair, and is increasingly often off the floor.

See research conducted by Maria Klawe et al. into the use of computer and video games by boys and girls; Klawe, M. et al. We have never-forgetful flowers in our garden: girls' responses to electronic games,
unpublished research, Vancouver/Kingston: E-GEMS, 1994

Our concerns with the observed asymmetry between game play styles of boys and girls also led us to develop two different computer games aimed at adolescent and older users, The Fifth Man, intended to appeal to men and boys, and Double Wedding, intended to appeal to women and girls. Both games were developed by the design firm LiveWires, and designed by Drew Ann Wake, with whom the author worked on several of the exhibitions described above. Both games use full-screen video to immerse the player in a specific television genre. The Fifth Man is based on solving an extremely complex crime committed via computer, and plunges the player into the world of the TV thriller. It involves solving a series of challenges such as cracking codes, sifting through bank accounts, and finally chasing the culprit through the virtual space of a map of Amsterdam.

Double Wedding is about water quality management, and involves the player in a process of scientific investigation, compromise, and consensus building in an attempt to reconcile two pairs of sweethearts, all in a style recalling popular afternoon soap operas. The subject matter was chosen according to research into subjects preferred by men and women, and in particular, the approach to Double Wedding was meant not only to attract women and girls by using a subject (the environment), a narrative supposition (romance), and a game style (investigation and compromise), but by using a graphic style (pink), activities (kissing) and game style, it was meant to discourage boys from monopolising the computer stations.

Unfortunately, both games have been plagued by the software problems endemic to all new development, so few conclusions can yet be drawn about the success or failure of these games in meeting their objectives. Provisionally it appears as if girls do favour Double Wedding, and boys The Fifth Man, although the first visitor to report having solved the mystery was a girl of ten years. Contrary to our expe-
rience in North America, these computer games do not seem to have the same magnetic power in attracting teenagers, and as a consequence, some of the assumptions about strategies to discourage excessive game play may not be appropriate in the European context.

One of the reference points we used during the design phase was the Launchpad exhibition at the London Science Museum, as it was easily visited and easily observed. Most of the exhibits in this exhibition represented 'traditional' science centre approaches based on the recipes found in the Exploratorium Cookbook. Exhibits were based on phenomena, took science out of context, and even the puzzle tables were stand-alone (quite inexplicable in terms of everything we had learned about puzzles and collaborative problem-solving). Moreover, they were all designed to fit into the same modular design, regardless of the nature of the activity. However, there was one striking exception, titled 'The Grain Pit'. This exhibit was in effect a large-scale machine that allowed visitors to move plastic, grain-shaped pellets by means of conveyor belts, Archimedean screws, bucketwheels and other devices. Bereft of any textual support whatsoever, the exhibit was nevertheless continually in use. Visitors of all ages seemed to be able to imagine different ways in which the grain could be shuttled from one spot to another, and would quickly start to work in teams to fill a bin faster, empty another, and so on. This seemed to us a very successful example of self-initiated and self-structuring activity elicited by a label implementing the user-language of problems.

As a consequence, we were inspired to create the Fabriek [the Ball Factory], whereby we hoped to elicit the same level of visitor activity, while creating a learning experience about the effectiveness of tools – the theme of the Technology zone. The Ball Factory is a large machine that distributes coloured balls to stations to be sorted and coded by the visitor. It is a complex piece of engineering, with balls constantly in motion being delivered to the four sorting stations and the four coding stations by means of pneumatics. Instead of the user-language of problems, we chose to implement the user-language of games. Large text panels explain the purpose of the Factory to the visitor.

Welcome to a special factory – a BALL factory.
This factory sorts and codes SIX different balls.
Both the YELLOW balls and the BLUE balls come in two sizes.
The small RED balls come in two weights.
Your assignment is posted on the computer screens.

Sort orders of SIX BALLS – by weight and by size – then send them away to be coded!

How fast can you make up the right order?

Computer screens at every station display a particular combination of balls, and ask the visitor to either sort them or code them as quickly as possible with the two tools at the station, putting the correct balls in one tube, and the rejected balls in another. At every station there is a tool for sorting by weight, and one for sorting by size, with instructions for their use beside each. When they are finished, they stop the clock by pushing a button and the six balls leave as a group to be sorted.

Both the activities of sorting and coding balls had been prototyped with groups of schoolchildren early in the design phase, so we were reasonably confident that they would work in the final version. However, once installed, it was clear that there were several factors that prevented the Ball Factory from working as effectively as we had imagined.

First, the goal of the game was not explicit. Despite the information on the computer screen, visitors were unclear about the purpose of the activity, the function of the tools, and the difference between the tube for the sorted balls and the one for the rejected balls. This resulted in frustration and chaotic behaviour, such as the stuffing of balls into either tube until the machine was blocked. This problem was addressed by placing large text panels explaining the Ball Factory nearby, rewriting the text on the computer screen, placing smaller versions of the main text at each station, and by clearly marking the two tubes ‘sorted balls’ and ‘rejected balls’. These changes had an almost immediate positive effect, signalled to us by the floorstaff within hours of their implementation. Once they understand the purpose of the game, and its rules, visitors seem quite prepared to engage with it for extended periods of time.

Second, there was inadequate feedback. Once an order had been correctly sorted, it was sent away to be checked, while the computer screen displayed the message ‘your order is being checked’. If all the stations were in use, the checking process could take as long as three minutes. This meant that for protracted periods there was no feedback to the visitor. We soon noticed that after only a matter of seconds without feedback, the visitor would become bored and restless. If an adult, they would leave the activity, if a child, they would begin to behave disruptively, attempting to block the machine, playing with the balls at random etc. To remedy this we planned
to add new sensors that give immediate feedback after each ball is selected, and adjusting the computer programme so that a new order is given as soon as the previous one is complete. These changes are expected remedy the feedback problem. \textsuperscript{101}

As of September 1998, due to financial restrictions, these changes have not been implemented. As a consequence, the author has been unable to confirm the prediction made above.

Third, the bar-coding activity was too difficult. As originally designed, the goal of the coding stations was to make up the bar-code corresponding to the order out of individual tiles describing the size and colour of each ball. Especially during busy periods, when the level of activity in newMetropolis was very high, visitors seemed unable to tackle this challenge effectively. As a consequence, we simplified the task to one of assigning a destination to each order of balls, a task consonant with the fictional Factory game. This strategy appears to have been a success.

Finally, due to the complexity of the Ball Factory and the inter-relationship between the mechanical system, the sensors, and the computer software, mechanical failures are frequent, and these failures obviously have an impact on game play. We observe that whatever the cause, any interruption to the continuous engagement with the game inevitably leads to chaotic behaviour and frustration.

Taken together in the Technology zone, the observations seem to confirm the conclusion that the threshold for users conferring the property of engagement on the label is consistently higher for the user-language of games than the user-language of problems, and the user-language of problems than other user-languages that do not confer the property of actorship. However, when the exhibit is successful, the rewards in terms of sustained, self-directed user activity of using these user-languages are correspondingly higher.

Energy:

\texttt{USER-LANGUAGE: problems (puzzles, Waterfall, exhibits)}

\texttt{games (Tankergame, Distribution)}

\texttt{TEXT STRATEGY: first-person (interpretive texts)}

\texttt{second-person (Tankergame)}

\texttt{- non-narrative interviews/newspaper quotes}

\texttt{- narrative (Tankergame)}

\texttt{TARGET GROUP: 7 - 10 (games) adults in family groups (texts)}

In the thematic zone Energy, aimed at families in groups, the user-languages of problems and games are both used extensively. The success of these user-
languages is in constant evidence, as the exhibits are in almost continuous use throughout the day. The zone features a large-scale puzzle (the Distribution Game), wherein the visitor completes different networks, surrounded by a series of puzzle tables. As some of the earliest research that inspired the strategies found in newMetropolis demonstrated the effectiveness of puzzles in eliciting visitor engagement, it was gratifying to see that this exhibit is in use constantly. The zone also features a large waterfall that empties into two water basins where visitors can make dams (which is also continually in use), and the Tankergame, wherein radio-controlled boats are raced to an oil platform, loaded, and raced back. The Tankergame has proven to be one of the most successful and most popular exhibits in newMetropolis, and is constantly in use. Notably, as the designers had expected, the game is played by groups, not individually. Most commonly there is a single player steering the tanker, and at least two ‘coaches’ – peers or parents – helping the player meet the game’s challenges. It is difficult to single out a particular exhibit for close examination, as the entire zone seems to support activity, with users moving from one exhibit to the next, staying for substantial periods of time with each.

The only notable failures in terms of sustained visitor activity are the exhibits along the Energy Wall, which have never been completed, and the GeoLab, an enclosed space containing a geology-based exploration game. The GeoLab raises some of the same issues raised by the Debate (described above). The occasional visitor finds it difficult to engage with the game’s challenge of finding oil in a difficult subterranean geology, and rarely stays to complete the research needed to win the game.

On the other hand, as with the Debate, teachers find the exhibit extremely effective, as they can prepare their class for the challenge, and structure the activities in such a way as to make the game a worthwhile challenge. This dual behaviour was noted early, and the GeoLab has been included in all the products destined for teachers and schoolclasses (the Starter’s Kits) which account for some 120 000 visits per year.

The text in the Energy zone is unusual in that it consists only of newspaper clippings or transcriptions of interviews – there is no ‘museum voice’ that claims to be a neutral authority. The visitor is confronted with sometimes conflicting opinions about how to make trade-offs between energy cost, lifestyle, and the environment, which is intended to promote discussion among adult visitors. The following is an example of the texts in the Energy zone:
Voorraad gas, kolen, en olie is eindig / Running out – not everyone agrees

Er moet op de rem worden getrapt,

e bodem van de aardgas- en

aardolievoorraden komt binnen
enkele tientallen jaren in zicht.

En ook de uraniumreserves zijn eindig.

De Volkskrant, 31 augustus 1991

"I don't believe we will be out of oil in 40 years."
Sean O'Dell, Chief economist of the International Energy Commission, The Economist, October 1995

Although it is apparent that all the exhibits are used extensively by younger visitors, it is difficult to evaluate the effectiveness of the text strategy for adults. However, if it is any indication, during the first three weeks of operation, all the text panels nearest activities generally monopolised by younger users (the Tankergame, the Solar Energy activity, the Distribution Game) had become 'dog-eared' due to the large number of visitors picking at them. While this is certainly evidence of the amount of time people are willing to wait for a turn at the games, it may also indicate a certain kind of engagement, during which the texts may also be read.

Humanity:

USER-LANGUAGE: problems

TEXT STRATEGY: third-person + first-person gloss
- non-narrative

TARGET GROUP: 12 -18-olds/adults

The zone Humanity occupies a special place in newMetropolis. Physically it is in the most dramatic space in the building, a 7 metre high splayed cone that forms the 'prow' of the ship-shaped building. It also plays a special role conceptually, as it signals the way in which newMetropolis has turned 'traditional' science museum and science centre thinking on its head. Traditionally science museums and science centres have been about science and technology. Only rarely have they strayed from the pure sciences, and then only into the easily exhibited subject of perception. In the past ten years there has been only one significant hands-on exhibition of psychology. newMetropolis, on the contrary, is not about science and technology. It is about being a human being in a world shaped increasingly by changes in science and technology, the institutional expression of Leonardo's ideal human figure.
In Fritz Lang’s ‘old’ film Metropolis, humankind had become enslaved by its machines. In newMetropolis, the intention was to celebrate the ability to retain control over technology, and assert humankind’s ability to actively create culture, whatever the technological means employed. As a consequence, the zone dedicated to Humanity, to human psychology and human creativity plays a central and fundamental role, and in large measure defines the way in which new-Metropolis is redefining the institution.

As originally planned, the zone Humanity comprised three distinct sections: a central ‘ring’ in which the visitor was the creator or artist, a second ring in which the psychological and physiological conditions for creativity, imagination, learning, and feeling were explored, and a third ring that looked at morality and making choices about right and wrong. Unfortunately, in late 1995, it was necessary for budget reasons to stop development of the third ring, despite the extensive prototyping that showed how important the issues of morality and choice were to our potential

The first two rings, however, remained intact.

The first ring was intended to be an area in which the visitor could directly influence the ‘emotional content’ of the space, by means of triggering images, sounds, and lighting effects. Several systems were prototyped, the first using slide images corresponding to emotions that changed in response to a user’s position relative to the screen, the second, a more complex system that displayed figures that responded differently depending on the user’s position. Both prototypes showed that as long as the cause and effect were too obvious, users tended to ignore the content of the images, and tried instead to understand the technology behind the system. As a consequence of these preliminary findings, we decided to approach a group of multi-media artists who could add another conceptual dimension to the activity, instead of continuing to try to develop the whole interactive system ourselves. After protracted negotiations, we contracted the Italian group Studio Azzurro, who had been one of the pioneers of interactive media art, and had several times been the winner of the prestigious Ars Electronica prize for interactive media. They proposed a programme entitled ‘il Giardino delle Anime’ – the Garden of Souls.

The Garden of Souls is an interactive environment in which images are projected on a large, crescent-shaped white carpet by video-projectors suspended overhead.
Each projector creates an image approximately 2 x 3 metres, giving a total interactive surface of approximately 9 x 4 metres. Under each image are an array of more than 30 sensors that signal the presence of a user anywhere on the carpet. This 'interactive carpet' is shielded along its back side by three large vertical scrims, which serve to define the space into two distinct areas. In its idle state, the carpet shows only images of rippled water. When a visitor steps on the carpet, the silhouette of a naked human figure appears out of the water, moves, and freezes. Subsequent motion by the visitor causes the figure to respond. All actions on the carpet are linked to atonal musical sequences. Although they appear to be a single surface, the six blocks are largely independent, and can respond to up to 20 visitors at any given time. There is no linear narrative, although certain sequences are linked to others. Over 300 micro-sequences of 3 - 6 seconds were filmed, each corresponding very allusively to an episode in the Greek myth of Ariadne, Theseus, and the Minotaur. At certain moments (about four times an hour), the images all freeze, and a 45 second 'dream sequence' is projected on the vertical screens. At other moments, in response to certain kinds of visitor activity, the images freeze, and the carpet is engulfed by images of flames, which turn to smoke, and then to water again to recommence the cycle.

As an interactive work of art in a public exhibition space, there were always questions about how visitors would respond. Studio Azzurro had presented similar pieces in the past, but only in art gallery or art museum settings, where the number of visitors was far less than at newMetropolis (which can have over 2000 visitors in the building at any given time). From the outset we were concerned that with large numbers of visitors on the carpet at once, they would be unable to identify the consequences of their own activity, thereby receiving no feedback. We were also concerned about the length of the sequences initiated by the visitor - if they were too long, the visitor's activity was reduced to being a human switch, unlocked a predetermined narrative.

To a certain extent, our concerns proved to be well-founded. The Garden of Souls is an effective, powerful, and emotional work of art, and is a unique experience for a science centre, and thus fully meets newMetropolis's goal of signalling the importance of human activity, and the zone's goal of expressing the importance of the emotions to Humanity. However, the experience falls short of expectations in several regards.
First, it is difficult to understand. Many visitors do not understand the carpet is interactive, and walk across it without noticing the changing images. Even when they do understand that their action initiates a change, they do not know what kind of change to expect. The convention of the image freezing, and of visitor motion to 'un-freeze' it, is not understood by many visitors, and leads to frustrated activity such as stamping on the image, jumping up and down, etc.

The fact that the image does not actually respond to the visitor, but merely moves, is often unsatisfying. At a future date, it is planned to create a live interactive opera, wherein live actors playing the silhouettes can see the visitors 'above' them, and respond to their presence in real time. In addition to being a performance, this would have the secondary advantage of testing whether direct feedback enhances visitor activity with the carpet.

Second, its capacity is limited. As we had suspected, when there are too many people on the carpet, there is no way of determining which visitor action caused what effect, reducing the carpet to a horizontal projection screen for images of naked bodies. In the early weeks of newMetropolis, visitor numbers were so great that we considered adding additional 'soft' restraints, such as the restriction that visitors should remove their shoes before walking on the carpet. Visitor numbers decreased after the first month, and there is no longer a need for this restriction. Most of the time the number of visitors on the carpet is low enough for visitors to see the consequences of their actions.

Third, interaction is constrained. Despite the enormous, if not infinite, number of combinations possible with the over 300 sequences, each sequence is nevertheless pre-determined. The longer the sequence, the longer the visitor has no control over the image. In the case of the longest sequences (18 - 20 seconds) the visitor is reduced to being a human switch, turning on a mini show. This oscillation between the roles of actor and spectator is even more acute in the case of the dream sequences, which interrupt visitor activity quite brutally, freezing the images on the carpet with a 45-second three-screen episode. Also, due to the way in which the sequences were filmed and the computer programmed, it takes a short time for the carpet to respond to the visitor, and for an image to sensibly change. As in the Ball Factory described above, any lag between action and feedback results in frustration and confusion, and often prompts chaotic behaviour such as stamping, jumping, or disinterest.
In the case of the Garden of Souls (also called the ‘Living Carpet’) these drawbacks do not mean the experience is a failure. In fact, some quite delightful behaviour is unlocked by the carpet for reasons quite unforeseen by the design team. By virtue of having chosen carpet as a projection surface (a decision made quite late in the design process for reasons of maintenance) we find many visitors, especially young children, instead of stepping on the figures, lie down beside them and mimic their actions, playing with their own silhouettes and those of the figures. Others jump from one square to another to see what happens. Still others try to capture the projected images in their hands. Perhaps one of the greatest strengths of the experience is its capacity for virtually unlimited play – without an explicitly-defined user-language, but an implicitly vast potential to create change – the visitor can generate an infinite amount of variety without in any way detracting from the experience of the whole, for herself or for others.

The second ring of the Humanity zone is divided into four clusters, grouped on either side of an island of computer stations that allow visitors to conduct a range of psychological tests. The clusters treat the themes ‘Thinking’, ‘Feeling’, ‘Imagining’, and ‘Interacting with one another’. Each of the clusters has a series of activities and puzzles that challenge the visitor to explore the ways in which the human mind operates.

The text strategy of the Humanity zone is unusual insofar as the main texts were written in the ‘classic’ third-person voice of the expert, in this case the Humanity zone’s researcher Diana Issidorides, whose PhD is in psychology. However, to avoid the impression that the texts were meant to be authoritative, we invited psychologists Jonathan Miller and Richard Gregory (and their Dutch counterparts) to comment on the texts, and we incorporated their comments verbatim as a ‘gloss’ on the main texts, even when these comments directly contradicted the text itself. For instance, to a text about body language, in which Diana had written that the body was silently speaking, Jonathan Miller responded ‘I feel this contains a recurring error that should be put right. Although undeniably the body communicates – is it right to say it is silently talking? The whole point ... is that it is unlike a language – no-one can say I gestured ungrammatically.’ This gloss was placed adjacent to the main text.

Many of the exhibits derive from those developed by Dr. Caryl Marsh for The Psychology Show, such as the rotating heads that challenge visitors to match facial
features to emotional states, and the exhibit on obedience, which indicates two entrances, on for foreigners, and one for natives, both leading to a video presentation of the Milgram experiment conducted in the 40s. In this zone are also found exhibits on perception and illusions that can be seen in many other science centres.

Several exhibits are completely new, and have proven to be highly successful.

The 'Test Yourself' stations, featuring short psychological tests developed in conjunction with the Rijksuniversiteit in Groningen, are always occupied, and visitors tend to stay at them for a considerable length of time.

The exhibit 'Love is' allows visitors to record a short video clip of their comments on the nature of love. The last nine visitors' comments are also available on the screen for review, thus allowing visitors to respond to other visitor's comments. When the exhibit was prototyped, we had been concerned about the possibility of irrelevant, unstructured, and anti-social comments, having seen from visitor comment books the way in which a single obscenity can prompt a string of similar comments. On the other hand, we opted for a subject about which visitors could be expected to feel strongly, and thus hoped that this would provide enough structure to avoid too much 'noise'. In practice there has been very little chaotic use of the exhibit, and visitors discuss their opinions among themselves before committing them to video.

The exhibit 'Feel the music' also lived up to the expectations we formed during the prototyping phase. In this exhibit visitors listen to two different pieces of music, and then determine whether the music was rough or smooth, warm or cool, sweet or sour, etc. The prototype of this exhibit was extremely successful, with over 100 visitors filling out their conclusions in just under six hours. The final version seems equally successful, and elicits a high degree of co-operation, discussion, and comparison.

Consistently we observe a very high degree of engagement with all of the exhibits in the Humanity zone, due in large part to the use of the user-language of 'problems', and that visitors are prepared to invest a large amount of time in order to explore a subject of deep personal interest – themselves.
The thematic zone Interactions is aimed primarily at younger teenagers, and comprises three linked computer games sharing a concern with interactions, or exchange. In theoretical terms, all three illustrate the properties of dynamic systems—‘Financial Transactions’ (‘Superbankers’) places an emphasis on equilibrium, Telecommunications (‘Get Connected’), on flow, and Mobility (‘On the Road’) on capacity. All three take advantage of the user-language of games—Superbankers and On the Road were conceived from the outset as finite games with closure rules and a time limit, Get Connected was conceived as what Carse calls an infinite game, although subsequent modifications have rendered it more like a conventional game than what was originally intended. Superbankers and Get Connected are described in detail below.

Superbankers is a game about money. Money is at the heart of the global economy—making it, investing it, spending it. Superbankers looks at the skills needed by modern banking. The entire area is a single game comprised of several individual computer games. The player has Dfl 50 000 and fifteen minutes to make as much money as he can by using a combination of the computer games. Each of the individual games is computer-based, and treats a different activity in the spectrum of creating wealth— from work, through saving, investment, and speculation, all the way to counterfeiting. In the central trading ring, visitors are put in the shoes of a broker, and see how information and events influence the behaviour of three very different markets: tulips, cattle and currency futures. A tulip market is affected by local information, a cattle market by European information, and the stock market, by global information. Thus a cold winter may spell disaster for tulip prices, while an earthquake in Tokyo may ravage the value of your KLM shares. The player is coached through the game by a pair of video hosts, who suggest different strategies and comment on the player’s performance. In the final analysis, however, it’s the player who calls the shots.
After two weeks of operation, it was clear that this game still needed a great deal of development. However, certain things were quite clear. First of all, the user must be aware that the entire set of games comprises a single, large game - something neither common, nor immediately obvious. Second, despite their relationship in the greater game, the obstacles in each of the individual games must be minimised. This is particularly apparent in the trading ring. As originally designed, it mirrored the real trading floor, and is played in rounds, or 'rings' of three minutes. This meant that players entering during a round had to wait until the next round begins. Moreover, as the larger game would have that you can only trade what you have earned, players are discouraged from beginning with the trading ring.

From the outset, it was clear that our visitors had different expectations. They wanted to start with the trading ring, and they wanted to start right away. The architecture of the zone clearly suggests first, that the ring is the central element, and second, that it can be played with others - and clearly the conclusions visitors draw from these clues mitigate against playing the game the way its designers had originally imagined. In fact, real use has pointed out to the designers the contradictory messages being sent by the exhibition architecture, the graphics, and the rules of play.

Our first step, therefore, was to reconcile these contradictions and modify the game so it takes advantage of the user's intuitive responses. This we did by making the trading ring a continuous market, thus allowing players to enter the market at any time, and to begin play as soon as they wish. The effect was striking, and immediate. The Trading Ring, instead of having a handful of participants trying to understand the rules, was packed continuously by players at every station, buying, selling, trading. The change was so remarkable in the Tulip Market (the game newMetropolis opened with), that the Stock Market was modified to allow the same continuous play, and has subsequently shown the same success. As the game is played by using a magnetic strip card that identifies the player, we can now see that a large percentage of players understand the game, and use the different stations to accumulate more money. We have also noticed that several players have already bought year subscriptions to newMetropolis, and come regularly to play the game (this is happening with all of the games throughout the institution, each game having its own devotees). A further endorsement of the success of the Superbankers game is the attention it has attracted in the professional community
in 1998 it was awarded the top prize for interaction design at Hannover’s prestigious CeBit conference.

Get Connected is a network of computer stations, each equipped with its own video camera and microphone which allows players to communicate with each other. The central feature of this area is an interactive game based on ‘Quartet’ (the English equivalent is ‘Fish’) developed in conjunction with MediaLab and former MIT MediaLab student Mike Murtaugh. In this game players negotiate with each other to exchange ‘cards’ to complete different sets, using a dynamic interface which responds to their choices and prompts new ones. In the original version the cards carried images that corresponded to sets such as flags, wild cats, towers, and so on. Every card belonged to at least two sets. For instance a flag of Spain could belong to the set ‘flags’ or the set ‘Spanish'. A Picasso painting could belong to the set ‘art’ or the set ‘Spanish.’ This game was intended to be inherently more open than Superbankers, and was designed so the player could adapt his activity to suit the circumstances. If there are fewer than ten players in the ring, the empty places are played by intelligent agents – ‘phantom’ players.

In many significant ways, Get Connected is among the closest newMetropolis has come to creating an environment in which the activity – and its content – is completely user-driven. Get Connected registers every player’s activity, and makes this activity available to other users. At the same time, the user decides for himself among an unlimited number of strategies for game play – the players are free to shape the game in any way the wish, regardless of the original assumptions of the designers. This open-ended, endlessly modifiable game structure, which can be continued as long as there are players to play it, we hoped would get close to what Carse calls an ‘infinite game.’ And, just as Superbankers starts with the trade as the fundamental unit of financial transactions, in the centre of the circle of video-conferenced computers in Get Connected is a circular bench around which people can sit. In the centre of the circle are projected surprising and sometimes startling images, which we hope will prompt people to initiate conversations – the fundamental act of communication.

Our experience with the first 50 000 visitors again showed us the importance of the user understanding, and more importantly, appropriating, the intention of the activity. When the game was first put on the floor, the emphasis was on the process of exchange. An introductory sequence explained the ‘rules of the game’, how to...
make sets, how to exchange, and established a value for each successful exchange, in one of four languages. After very little time it was clear that the experience was confusing. The user was not prepared to follow the introduction, and was more interested in using the microphone and video link to contact other players than in playing the game. This in itself we took to be a positive signal, and in fact we observed teenagers using the video links to flirt with each other. In one case a teenage girl covered up the video lens when contacted by an unknown young man – in another case we saw a young couple chatting briefly, an hour later we saw them spooning in a corner. Clearly the exhibit could be called a success – at least in some respects!

This phenomenon should not be underestimated. We had learned to our chagrin in the Hotseat! theatre in *Mine Games* how difficult it was to get people who did not know each other to collaborate openly. Hotseat! proved to be a remarkable success when the participants all knew each other, or were drawn from similar backgrounds – in short, with groups of homogeneous users, such as school classes or families. On the other hand, it was a complete failure with heterogeneous groups such as a normal Saturday afternoon science centre audience. At least in North America (and even more in Europe) visitors are extremely reluctant to initiate contact with strangers. In Get Connected, the first thing we noticed is the willingness to make contact – when ‘masked’ by the interface of video and computer screen. This phenomenon of masking has already noticed on the Internet, where there is extensive evidence of users disguising their identity, secure in the knowledge that their correspondent was unable reveal their deception. In Get Connected, the correspondent may be sitting directly behind you, no further than 5 metres away, so the possibilities for deception are dramatically reduced. Nevertheless, the fact of having a screen, and of having a certain psychological, if not physical, distance from the other players, creates the conditions for overcoming an obstacle that has dogged the museum since its inception.

We soon saw that users seized on the idea of making contact, and that they engaged quickly in communicating with each other – and that contact was sustained. What was missing, however, was a clear and intuitive understanding of the latent possibilities of the exchange, of structuring the nature of the contact. The graphic interface was modified several times to make the exchange process more clear. The cards of the other players were displayed more easily, the cards to be exchanged were highlighted, the length and complexity of the
introduction were reduced. None of these modifications seemed to increase the amount of structured activity among users. The game was originally based on the Dutch children's game 'Quartet', but at the time it was felt that this was too simple a structure to maintain user interest, hence the decision to create sets of images corresponding to various social and cultural categories. In this regard we appear to have been mistaken – the problem appeared to be the unnecessary complexity introduced by the additional designer-invented (rather than user-driven) card categories.

We decided to take a drastic measure. We replaced the sets of images with real cards – from ace to ten, in the four suits. Almost immediately we noticed an increase in structured and sustained activity. Visitors whose microphone failed could be heard to shout to other visitors 'I'm looking for tens!'. Clearly the users understood what sets were and how they could make them. Another modification also increased structured activity. This was to replace rewarding players with points for making sets, with a time reward. The user was given a fixed amount of time in units on her 'phonecard' to start with, and the number of units decreased with time. More units could be added to the card by successfully completing sets. These changes were implemented only a few days ago, but the increase in activity, co-operation, engagement, and concentration is very noticeable. Some players now manage to stay in the ring over twenty minutes, and we soon began to notice repeat users (who purchased year subscriptions) coming in regularly to play the game.

The developer primarily responsible for the game, Mike Murtaugh, drew the following conclusions:

In sum, the major conceptual changes to the game involved reducing the amount of information that needed to be explicitly communicated to the participant. By relying on cultural knowledge of card games, and simplifying the two core activities of the game – making person-to-person connections and exchanging cards – we reduced the need for additional mechanisms to request and receive information (e.g. clickable 'category' labels, text prompts to indicate incoming and outgoing calls or 'exchange state'). As a result, we saw a dramatic shift in the focus of the experience from its mechanisms to its larger purpose as a game.

In casual observation of the initial installation, players seemed primarily focused on how to connect to another player. Visitors would sit down and immediately attempt to contact another station by clicking on its number. When no result appeared to occur, players would tend to begin frantically clicking on other stations in an attempt to 'make
something happen. Eventually, if and when a connection was established, players were excited and satisfied (particularly if they knew the other player). This pleasure of simply making a video connection seemed for some visitors (particularly young children) sufficient to justify the apparently ‘mysterious operation’ of the underlying system. Once connected, players tended to exhibit ‘unfocused’ social activity – either nervously acknowledging a stranger or (most frequently) making broad visual gestures, particularly if they knew the other player. Finally, players were for the most part not talking about the game elements (the countries or themes) and not making (intentional) exchanges.

With the addition of the standard playing cards and the phone card, however, this behaviour was observed to dramatically change. Players immediately were heard talking about elements of the game (‘heb je een seven voor mij?’, etc.) Connections between players were much better understood to be a part of a larger task, and players seemed more comfortable (and focused) when connected. By reducing the visibility of the game mechanics, players were able to focus on the game itself which, in turn, provided a justification and purpose to the activity of making the connections.

What conclusions can we draw from this experiment? Most importantly, it seems that in any activity based on the user-language of games, further constraints on the activity do not seem to hinder it, in fact, they often seem to unlock activity and increase the quality of the interaction, providing the intent behind the constraints is clearly communicated. Moreover, by making information available to users as they need it, in this case by means of the video link to other players, creates the possibility of sustained play. In all cases, the user-language of games, by creating the property of other players and actorship, supports the possibility of sustained, self-directed play.

In March 1998, in collaboration with the French Cité de la Science et de l’Industrie, we began implementing a broadband, realtime connection Amsterdam/Paris, wherein players in both cities could exchange cards freely, playing in ‘mirror’ sites. It is hoped that the next step will be to extend the game to users on the Internet, who will be able to join in the play in Amsterdam from sites around the world.

**USER LANGUAGE:** problems

**TEXT STRATEGY:** third-person

**TARGET GROUP:** all ages
As a one of the key aspects of its mission, newMetropolis was to be a ‘kennis centrum’ – a knowledge centre where people could come to just find out about the world around them. As a knowledge centre, newMetropolis was organised along two main axes – ‘Labour’, and the ‘News’. These themes were used to organise opportunities throughout the building for visitors to get information about scientific and technological issues. It was hoped that visitors would come to expect newMetropolis to be a source of information about what is new in the world of science and technology, and how to make sense out of the vast amount of information available by means of the modern media. Equally important was the importance of staying up to date, and signalling to the visitor that whenever they returned to newMetropolis there would be new, up to date information.

Central to the concept of newMetropolis was the belief that the exhibits should place their emphasis on communicating skills rather than information – on conferring actorship. This emphasis stemmed in part as a response to the traditional museum approach that saw information as an end in itself, with the role of the museum as the broadcaster of that information. In contrast to most educational games, which treat the information itself as the reward for the activity, newMetropolis; information alone was seen as a secondary outcome of engagement with intrinsically rewarding activities, rather than the reward for those activities. As a consequence, we developed our exhibits as games and puzzles (employing the user-languages of problems and games) whose first goal was to be compelling and enjoyable, rather than be sources of information.

Nevertheless, given our commitment to the library-model of use, we recognised that information was essential to support visitors in their exploration of new experiences, and that this information should be available when and in whatever detail the visitor needed. In most museums, the amount of information available to the visitor is limited by several factors. In every institution, there are limits to the curators’ knowledge, their desire to communicate, and to the institutional structure to create new information. There are also significant technical constraints to the traditional media. There are limits to the amount of information that could be put on traditional supports such as text panels. There are limits to the changes that can be easily made to printed text, images, and videos. There are often budget limits how often printed text panels and videos can be changed to bring them up to date.

All these constraints have been largely overcome by the development of global information networks, collectively known as the Internet. As a consequence, the
Internet plays a central role in newMetropolis’s information strategy, not only as a technical support, but as a key determinant of information strategy. newMetropolis’s information strategy operates at several levels – for the visitor, for distance users, and for the staff. The vehicle for the newMetropolis information strategy is the ‘Actua’ [short for ‘Actualiteit’, or ‘news’] system – an internal and external information network.

Actua is not a thematic zone like those described above. The Actua corners are styled on a common feature found in most Amsterdam cafés – the reading table. In newMetropolis, these tables host networked computer stations which show daily updated face of newMetropolis, presenting what’s happening now in the field of science, technology, industry, and society, and the homepage is divided clearly into two halves – ‘inside’ and ‘outside’. The outside half provides direct structured access to a variety of information sources including CNN, the Volkskrant, Wired magazine, via the Internet. The inside information gives up-to-date schedules of events and demonstrations, as well as providing a global orientation to exhibits in the building. Using a three-dimensional rendering of each floor, the visitor can click on any exhibit in newMetropolis to bring up information about that exhibit. Each page provides specific links to Internet information resources relating to issues in the news, changes to the nature of work, and background information about the science and technology underlying the exhibit. In addition, the visitor can select ‘workshop’ and suggest modifications, text changes, or other activities, and send them directly to newMetropolis development staff.

Actua terminals also support a range of other activities to promote discussion and debates. In the autumn of 1997 four of the terminals were dedicated to a debate conducted by the Ministry of Agriculture and Land Use (the VROM) on the future of Holland in 2030. On these terminals visitors could listen to a selection of points of view, and having heard at least four, vote for a possible future scenario. To support direct visitor participation we developed a unique interface that allows visitors to type in their comments while listening to a video interview, thus providing immediate feedback, and information about visitor responses to particular positions. The research report based on this experiment was presented to the Visitor Studies Association in August 1998.114

The ‘interface’ between the institution and the outside world is managed by a special team at newMetropolis whose task is to balance the information needs from the ‘inside’ with the offer of information available ‘outside’. The team is responsible...
for retrieving the latest news and the relevant information to display in the Actua Hoeken. The sources can be news wires, Internet sites, TV stations, etc. The team is also responsible for bringing the ‘pulse’ of the real debates and discussions in science into newMetropolis. The Actua corners are only one use of this information – the entire staff profits from this constant ‘open window’ to information provided by the Actua team to shape the development of new programmes, demonstrations, exhibitions, and ‘pop-up’ acts.

Since newMetropolis opened in June 1997, the Actua terminals have played a far more important role than originally expected. Originally designed to be an information resource (a role they perform exceptionally well), they are increasingly used as a communication tool: from visitors to staff, from floor staff to development staff, and from development staff to both floor staff and visitors.

By August 1997, just two months after opening, over 60 comments from visitors and floor staff were being received daily from the Actua terminals. Visitor comments come directly, and are answered by letter. Comments from floor staff are responded to by development staff, and the responses posted on a special page. This resulted in an extraordinary degree of awareness of the operation of the exhibits on the part of the development staff, and has given an important voice to floor staff in making comments, criticisms, and suggestions for exhibit modification. In effect this allows newMetropolis to continue to function as an experimental prototype while continuing to be a public institution. It also injected a degree of reflexiveness into what is often a rigid and unresponsive ‘top-down’ process of floor staff having to accept the consequences of development staff’s experiments. This involvement of floor staff into the development process has been further enhanced by including floor staff in the development of all new products and programmes.

If the Actua corners have had a failing it is in the fact that there are too few of them. When the building is crowded, there is intense competition for the eighteen computers, and often they are monopolised by teenagers, preventing adult users from gaining access to information. As a consequence, adults frequently complain that there is little for them, seeing only the game-like exhibitions, and unaware of the vast information resources available on the Actua terminals.

After the first three months of operation, what were we able to conclude, however provisionally, from the experiment conducted by the author at newMetropolis? First of all, we can make the following observations with a high degree of certainty:
VISITORS SPEND A LONGER TIME WITH THE EXHIBITS. Just days after new-Metropolis opened, we were struck by the fact that visitors seemed to be spending longer at the exhibits than in other science centres we knew. This finding was born out by the results of our first visitor surveys, implemented both on the Actua terminals and on clipboards beside exhibits, that showed 155 visitors out of 210 declaring to have played exhibits for longer than 5 minutes, of whom 80 said they played longer than 20 minutes with a single exhibit. This figure can be compared to research done on other science centres \(^{116}\) that shows an average engagement with traditionally-designed hands-on exhibits of under two minutes. This sustained engagement, which can be attributed largely to the user-languages of the labels, and to the ‘bottom-up’ approach based on putting the exhibitions in context, can be considered powerful evidence in favour of the theory outlined in the pages above.

VISITORS COLLABORATE WITH ONE ANOTHER. Another striking finding was that our exhibits were successful in encouraging visitors to collaborate with one another, most often with family and friends, but also, notably in the case of Get Connected, with other previously unknown visitors. The survey showed that over half of our visitors collaborated with others visitors, and over 20% collaborated with visitors other than family and friends. Given that one of the four key objectives of our exhibits was to encourage collaboration, this can be seen as a success. This success also indicates that the user-languages of problems and games, both of which confer actorship, support interaction with other users, a finding we had observed as early as 1988 at the Puzzle Table at the Ontario Science Centre.

COMPUTER GAMES ARE CREATING REPEAT USERS. Even after a matter of a few weeks of operations, and despite the inevitable software problems associated with new computer games, floor staff began to report repeat users of all the main computer games – the three games in the Interactions zone, and the Tanker Game\(^{116}\) in the Energy zone. These users, mostly teenage boys (although the On the Road game seems to have a following among young women) had already decided to invest in year’s subscriptions to newMetropolis and were coming three and four times a week to play specific games. This was initially seen as a problem, as these users tended to prevent other visitors from playing, but staff are preparing a programme whereby they are given extra playing time after closing hours, in return for coaching new players on how to use the games.

CREATING STRUCTURE UNLOCKS ACTIVITY. In the case of games, constraining and clarifying the rules seem to have the effect of stimulating variation, rather than

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\(^{118}\) see Kramer, J., Pereira, P., en Wacano, C. Life is a tankergame: Psychology or philosophy? Sociale psychologie Vrije Universiteit Amsterdam; March 1998.
limiting it. This was particularly the case in the Get Connected game, described above, where the game had to be drastically simplified before it became a self-sustaining, user-driven activity, and it also seems true in the case of other game-like exhibits. Games seem to invite variety by constraining the conditions under which the variety occurs. If the rules are too complex, the goals unclear, or the play too open-ended, confusion and frustration seem to result. However, if the goal of the game is clear (whether implicit or explicit), and the rules for playing accessible, the user-language of games clearly supports sustained, self-directed activity.

**Users Sometimes Need More Information To Structure Their Activity.** Visitors need to know what the goal of the activity is, and what to do to use it successfully. Providing too little information, rather than opening up possibilities, seems to inhibit them, and results in frustration and confusion. This need for information was observed most acutely in exhibits relying on the user-languages of observation or variables. In the case of the Ripple Tank (in the Science zone) for instance, we had deliberately avoided creating a device that would make the required waves for the experiments, believing that visitors would have a richer experience if they made the waves themselves, then examined their behaviour. Instead, not knowing what kind of wave was required in order to observe the properties of waves, the visitor was unable to make the exhibit 'work'. We have now included a small device that makes regular waves, and an illustration of what a regular wave-form looks like, and visitors are now seen experimenting with the effects of bouncing waves off different surfaces, which is indeed the activity the exhibit is meant to support.

Our certainty has now increased with the passage of a full year of operations, and during the first year, the observations sketched above have been largely confirmed by newMetropolis researchers – over a dozen graduate students have made new Metropolis exhibits the subject of their research, which has included several 'eindscripties' (Master's theses). Specific exhibits researched include the 'Get Connected' game117 in the Interactions zone, the Tanker Game118 in the Energy zone, the use of the newMetropolis roof as a social space 118, the effectiveness of the Actua computers in supporting debate about the future of Holland 139, and the effectiveness of the Starter's Kits in supporting high school teachers and their students.120

From the experience described above, I would argue that if we see museums as support systems, and their labels as supports that implement specific user-languages, we are in a position to make more effective exhibitions, and, as a con-
sequence, better museums. Let us recall De Zeeuw's definition of the features of a support system: a support system is open to any individual without any form of prior constraint other than the desire to use the system to maintain or increase their competence. A support system suggests to users a specific form of use, and possible extensions to this use, where a flow of information will provide the user with the additional resources needed, and, at the same time, be available to other users. A support system has only linguistic constraints on the information flow, and these constraints constitute the 'user-language' of the support system. A support system supports the activities of the user, which stem from the user's own interests, experience and existing competence. A support system does not impose a model of the user, nor a model for the activities or the variation brought by the user. A support system maximises variety on the part of the users, and maximises the continued use of the support system in such a way that this activity is augmented and encouraged. In this way, the support system serves as a means of recognising, responding to and enhancing the user's competences.

Seen in this way, newMetropolis can be clearly described as a support system. It succeeds by putting the emphasis on the user – not by modelling him in advance, but, like a good library, allowing for and supporting the activity of an infinite number of unknown and unknowable future users by creating labels. User-languages, when implemented as labels in a context relevant to the user, consistently confer specific and predictable properties. By implementing user-languages that confer actorship – the user-language of problems, in the case of the library, augmented by the user-language of games, in the case of newMetropolis, these labels support their unknown and unknowable users. The success of newMetropolis serves to confirm the usefulness of the theory described above in creating new kinds of labels and ultimately, new kinds of museums.