

Horizons2020

A thought-provoking
look at the future

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A study report of
TNS Infratest Wirtschaftsforschung, Munich

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Foreword	IX
1 The Horizons2020 scenario	1
1.1 Focusing on the future	1
1.2 The term “scenario”	4
1.3 Horizons2020: Requirements and expectations	5
1.4 Methodology: The scenario	7
1.5 Methodology: The expert survey	11
1.6 The regions covered	12
1.7 The optimism index	14
2 Scenario 1 – Life in the year 2020	17
2.1 General situation	17
2.1.1 Politics	17
2.1.2 The economy	21
2.1.3 Environment and infrastructure	24
2.1.4 Technology	26
2.1.5 Social values	29
2.1.6 Demographics and social structures	30
2.2 Life in the year 2020	32
2.2.1 Lifestyle	32
2.2.1.1 The modest society	32
2.2.1.2 The attraction of a slower pace	33
2.2.1.3 From the age gap to generational integration	36

Content

2.2.2	Old age	36
2.2.2.1	The gray society	36
2.2.2.2	The role of the aged in shaping the present	37
2.2.2.3	The final phase of life	38
2.2.3	The family	39
2.2.3.1	Parents	39
2.2.3.2	Young people	41
2.2.4	Home life	42
2.2.4.1	Home life as the core focus of life	42
2.2.4.2	Smart homes	42
2.2.4.3	City life	44
2.2.4.4	The new “cities outside cities”	45
2.2.4.5	The new face of rural life	46
2.2.4.6	The convergence of public and private transport	47
2.2.5	Work	47
2.2.5.1	Jobs	47
2.2.5.2	Corporate management	48
2.2.5.3	Goods and services	49
2.2.5.4	Customer relationships	51
2.2.6	Consumer behavior	52
2.2.6.1	Conscious consumption	52
2.2.6.2	Price-aware consumption	53
2.2.6.3	Gray consumers – a new target group	53
2.2.6.4	Back to reality	55
2.2.7	Travel	56
2.2.7.1	Less long-distance travel	56
2.2.7.2	Vacation in one’s home country	57
2.2.7.3	Vacation at home	57
2.2.7.4	More self-determination in the choice of vacations	58
2.2.7.5	Stage-managed authenticity	58
2.2.7.6	Discovering Europe	59
2.2.7.7	City tours – a brief escape from the routine	59
2.2.8	Leisure	60
2.2.8.1	Focus on relaxation	60
2.2.8.2	The principle of slowness	60

2.2.8.3	Soft sports	61
2.2.8.4	Sports tailored to specific age groups	61
2.2.8.5	Games and relaxation	62
2.2.8.6	An understanding of European culture	62
2.2.8.7	A new theater culture	62
2.2.9	Media and communication	63
2.2.9.1	Electronic media and communication platforms	63
2.2.9.2	Use of the media, newspapers and magazines	64
2.2.9.3	Books	65
2.2.9.4	The Internet	66
2.2.9.5	The quality of communication	67
2.2.9.6	Defensive attitudes	67
2.2.10	Health care	68
2.2.10.1	A holistic view of health	68
2.2.10.2	Prevention is better than cure	69
2.2.10.3	Health insurers	70
2.2.10.4	Do-it-yourself health care	71
2.2.10.5	In-patient treatment outsourced to the home	71
2.2.10.6	E-health	72
2.2.10.7	Health care quality management	73
2.2.10.8	New methods of treatment	74
2.2.11	Eating habits	74
2.2.11.1	Organic foods	74
2.2.11.2	More is not always better	75
2.2.11.3	The ritual of cooking meals	76
2.2.11.4	Slow food	77
2.2.12	Education	77
2.2.12.1	Cultivating knowledge	77
2.2.12.2	Educational content	78
2.2.12.3	Quality management in education	79
2.2.12.4	Educational organizations	80
2.2.12.5	Copyright protection	80

2.2.13	Safety and security	81
2.2.13.1	Crime and terrorism	81
2.2.13.2	Infections and epidemics	82
2.2.13.3	Harmful substances	82
3	Scenario 2 – Life in the year 2020	83
3.1	General situation	83
3.1.1	The economy	83
3.1.2	Politics	86
3.1.3	Environment and infrastructure	89
3.1.4	Technology	92
3.1.5	Social values	95
3.1.6	Demographics and social structures	97
3.2	Life in the year 2020	98
3.2.1	Lifestyle	98
3.2.1.1	Fuzzy society	98
3.2.1.2	The egocentric society and the society of opposites	98
3.2.2	Relationships	102
3.2.2.1	Romantic partnerships	102
3.2.2.2	Personal networks	103
3.2.2.3	Gender roles	104
3.2.2.4	Singles	105
3.2.3	Home life	107
3.2.3.1	The living environment divide	107
3.2.3.2	Born to move	108
3.2.3.3	Living space functionality	108
3.2.3.4	Mobile real estate	109
3.2.3.5	A life center away from home	110
3.2.3.6	Industrialization of the construction sector	110
3.2.3.7	Transportation	112

3.2.4	Work	113
3.2.4.1	The delocalized workplace	113
3.2.4.2	Employee networks	114
3.2.4.3	Employee loyalty and employability	115
3.2.4.4	Business competition	116
3.2.4.5	The balanced scorecard	117
3.2.4.6	Brand management	118
3.2.4.7	New markets	118
3.2.4.8	Company networks	119
3.2.5	Consumption	120
3.2.5.1	Polarization between discount and luxury goods	120
3.2.5.2	Consumption as a symptom of yearning	120
3.2.5.3	Brands as a means of self-realization	121
3.2.5.4	Easing the burden of buying daily necessities	122
3.2.5.5	Experiential shopping	123
3.2.5.6	From products to full-service offerings	124
3.2.5.7	The new world of electronic shopping	124
3.2.6	Travel	126
3.2.6.1	Artificial vacation worlds	126
3.2.6.2	Premium vacations	126
3.2.6.3	Addiction to adventure vacations	127
3.2.6.4	The multifunctional vacation	127
3.2.6.5	Global hopping	128
3.2.6.6	Growth in business travel	128
3.2.6.7	Education on vacation	129
3.2.6.8	Budget vacations	129
3.2.7	Leisure	130
3.2.7.1	The leisure divide	130
3.2.7.2	Dramatized leisure	130
3.2.7.3	Self-promotion in the media	131
3.2.7.4	Achievement-focused leisure	132
3.2.7.5	Recuperation-focused leisure	132
3.2.7.6	Social leisure activities	133
3.2.7.7	Culturetainment	134

3.2.8	Health	135
3.2.8.1	Economic development of the health care sector	135
3.2.8.2	A functional perception of health	136
3.2.8.3	Vanity health care	136
3.2.8.4	The medical divide	137
3.2.8.5	Self-responsibility for health	137
3.2.8.6	From hospitals to health care conglomerates	139
3.2.8.7	Pharmaceutical companies and hospital ownership	139
3.2.8.8	New methods of treatment	140
3.2.9	Eating habits	141
3.2.9.1	Everyday food	141
3.2.9.2	Theme food	142
3.2.9.3	The nuisance of cooking	142
3.2.9.4	Faster food	142
3.2.10	Education	143
3.2.10.1	Education standards in Europe	143
3.2.10.2	Private education companies	143
3.2.10.3	Forms of learning	145
3.2.10.4	Public versus private education	146
3.2.10.5	Knowledge management	146
3.2.10.6	Internet content and user protection	147
3.2.11	Security	148

4	Siemens' Technology Reports	151
4.1	Production and Automation Systems	152
4.2	Power Engineering	163
4.3	Healthcare	186
4.4	Information and Communications, Biometrics	196
4.5	Materials and Nanotechnology	209
4.6	Transportation	221
4.7	Combining Biotech, Nanotech and IT	232
5	Attachment	249
5.1	Trend breakers	249
5.2	Advisory Committee	251
5.3	Descriptors	253
5.4	Glossary	282

Horizons2020 – Mapping the future

**“A scenario is never a definitive picture,
but a starting point for dialogue.”**

Horizons2020:

A thought-provoking look at the future

What will life be like in the future? What life choices will we be making and what decisions will be forced upon us? How will we live and work? Which technologies will make our lives easier? By what means will we communicate and obtain information? How important will mobility be to us? Will virtual networks alter the social fabric and the role of the family?

There are countless questions that one can raise about the future, and the methods by which the scientific community, the corporate sector, and society approach the issue of tomorrow's world are correspondingly diverse.

In search of answers, Siemens contracted TNS Infratest to conduct a survey among experts throughout Europe to find out what changes they thought we could expect to see in the economy, technology, the political arena, and society during the next 16 years. The outcome of this survey was Horizons2020, a communications scenario that takes a look into the future and presents two different depictions of what life could be like in the year 2020.

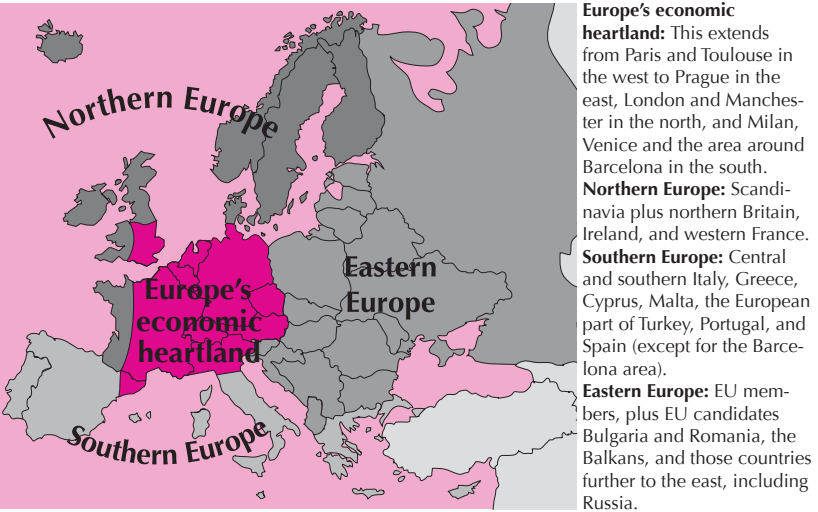
As a communications scenario, Horizons2020 sets out to create a basis for dialogue with the public at large. Unlike strategic scenarios, which aim to provide

Foreword

a precise roadmap focused on a specific outcome (say, greater profitability), Horizons2020 throws open a wide range of topics and offers a large number of starting points for dialogue and debate about the future.

Setting the survey's time horizon at 16 years from now means that the scenario relates strongly to the world today yet offers a longer-term perspective nonetheless. The year 2020 is sufficiently close to the present that we can recognize familiar aspects of life as it is now but also sufficiently far off that there are new things for us to discover, and that the old and new in combination present a credible overall picture. Horizons2020 builds purely on forecasts and trends that will remain valid in the long term and are not likely to be overturned by events in the shorter term.

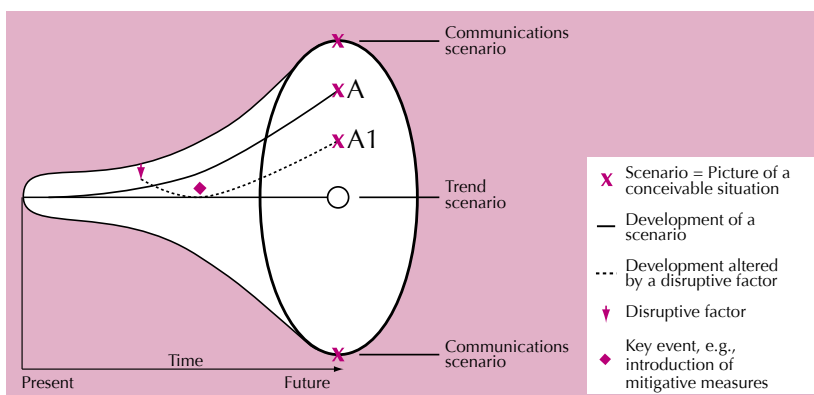
Horizons2020's geographic scope encompasses the whole of Europe, divided into four separate areas: Europe's economic heartland, Northern Europe, Southern Europe, and Eastern Europe.



The Horizons2020 project aimed to be comprehensive in scope and neutral in its approach – something underscored by the fact that it built on the opinions of experts from throughout Europe and that an advisory board was appointed as an oversight body. Furthermore, the range of possible courses of development examined, the methodology used to select them, and the ways in which they interlock in each of the scenario’s two depictions of the future avoid a polarized and judgmental interpretation of the future, divided into good and bad or black and white.

In terms of its methodology, Horizons2020 breaks new ground in that it combines environmental scenarios of a kind originally developed in the 1980s by the Battelle Institute with a quantitative expert survey. Using the results of the survey, the project team prepared two distinct pictures of the future – complete with descriptions of the respective political, economic, infrastructural, technological, social, and demographic environments – each representing alternative life worlds in the year 2020. Ultimately, the reality of life in 2020 might align exactly with one of the two depictions presented in Horizons2020, or it might occupy a space somewhere between the two depictions.

The scenario technique



Technological scenarios prepared in recent years in connection with Siemens research projects (like Siemens Corporate Technology's Pictures of the Future) have also provided input for the life worlds outlined in each of the two depictions of the future. These legacy scenarios help to establish a link between the societal aspects covered in Horizons2020 and Siemens' role as a creator of technology solutions.

The process of creating Horizons2020 began with the selection of five important life areas expected to drive change in the next 16 years: the political arena, society, the economy, the environment, and technology. The project team then identified 200 descriptors – qualitative and quantitative metrics – thought to be relevant to describing these life areas.

The descriptors were discussed in detail with the advisory board and divided into three groups:

- ten mega trends – key developments that were considered to be inevitable and to have a major influence on the shape of tomorrow
- non-critical descriptors deemed to be highly probable but not likely to have a pronounced influence on tomorrow
- 108 critical descriptors considered to have the potential to spark alternative courses of development and to play a decisive role in the future.

Two alternative courses of development were defined for each of the critical descriptors, and experts in the fields of economics, politics, society, culture, and technology were asked to score these alternatives in terms of their likelihood of occurring. Of the 671 experts contacted, 116 agreed to take part in the survey (71 in Europe's economic heartland, 16 in Southern Europe, 9 in Northern Europe, and 20 in Eastern Europe). The outcome of the two-stage survey was that 32 of the original 108 critical descriptors were rated as non-critical, leaving 76 critical descriptors, 152 alternatives and 2^{76} ($76 \times 10^{21} = 75$ billion trillion) possible alternative life worlds as a basis for creating the two depictions of the fu-

ture. Working with consistency software and scenario subsets, the project team then prepared Scenario 1 and 2, the two pictures of the future presented here.

Three basic conditions governed the creation of these depictions: First, each of a critical descriptor's two alternatives had to occur in one of the two depictions. Second, the greatest possible consistency had to be achieved. And third, the two depictions had to be comparable in terms of their appeal. In other words, the number of alternatives rated as positive by the experts had to be roughly equal in each of the depictions.

Scenario 1: Equality, freedom and modesty

Life in Europe in the year 2020 is marked by strong government, dedicated to ensuring security, equal opportunities, and freedom. In fact, government is in evidence everywhere, particularly in education and in health care, where it aims to guarantee citizens equal access to state services. Intermediary institutions like political parties, trade unions and business associations support the state in the fulfillment of its duties and help to ensure that the interests of their members and society as a whole are taken into account.

The most prominent change since 2005 is the rediscovery of the joy of taking things slowly. The once pervasive “faster, higher, further” mentality is on the decline in some areas of life and has disappeared from others altogether. People are looking to achieve a better balance between work and leisure. Out of a sense that the state takes them seriously, they have renewed faith in government, and they are willing to accept, or have acquiesced to, a situation in which they have a significantly lower personal income (and all that that implies for their own buying habits) in the interest of sustaining this change. Solidarity toward others is on the increase, as is a willingness to put the interests of the community first. The desire to have everything, here and now, is giving way to the wish to

enjoy and share things with others and to make provisions for the future. Society is starting to embrace and foster as virtues the ability to “coast” and to be more modest in one’s wishes. A healthy balance exists between the individual desire to achieve and a sense of social responsibility. This is evident at an economic level inasmuch as states in Northern Europe and Europe’s heartland make transfer payments to countries in Southern and Eastern Europe.

The high proportion of elderly people has led to a qualitative change in the fabric of society. At no time previously in history has such a high number of mentally and physically capable old people played so prominent a role in industry or in political and cultural life. Lifelong learning is becoming reality, even for older people, in the workplace and in education, and for teachers and students alike.

The business world has discovered the elderly as a growing target group with substantial purchasing power. Businesses are expanding and tailoring their product and service offerings to meet this demographic’s needs and requirements, and are realigning their sales and marketing efforts accordingly.

Neither the younger generations nor the state with its many financial commitments (including subsidies for medical research) can carry the burden of pensions unaided. Provisions for old age, now more important than ever, are therefore a key part of people’s life planning and are very much the responsibility of the individual.

The health and education systems, too, are affected by this demographic shift. More elderly people than ever are sick and in need of care. The number of doctors and caregivers and the equipment available in hospitals and nursing homes are insufficient to keep pace with the rapidly advancing ageing process in society. Here, too, though, society’s newfound solidarity and sense of values is an important factor. Private care services, neighborhood help schemes, and peer-run senior citizen self-help initiatives are all experiencing considerable growth and now offer an alternative to official health services. Health awareness campaigns and screening programs are becoming increasingly common. People also take active steps to maintain their general health, fitness and well-being by

keeping to a balanced diet and engaging in regular sport. The state is sponsoring basic research in the field of medicine and the development of new diagnostic procedures.

All of the key characteristics defining developments within society are reflected in the economy and the corporate sector. The economy is expanding steadily within the framework created by policymakers, and government's strong leadership role is helping to ensure that industry does not develop sufficient momentum that it could wield undue power over political leadership.

Like the individuals in society, businesses are placing increasing emphasis on active social responsibility and community initiatives. Corporate governance and corporate responsibility are no longer about image-building and have long since become cornerstones of good citizenship.

Over the years, national economies in Europe's heartland and Northern Europe have gradually become retail and service economies. For the most part, manufacturing has moved to Eastern Europe, and Southern Europe now lives primarily from tourism and second homes.

Governments are subsidizing key technologies in such areas as mobility, energy, security, telecommunications, and, above all, better infrastructure. The state, the corporate sector, and individuals alike all take active steps to conserve energy and protect the environment.

Scenario 2: Speed, networks and risk

The key role played by governments and the political arena in Scenario 1 falls to markets and global competition in Scenario 2. The state and society have given the corporate sector the latitude it needs to operate efficiently. Society has shown itself to be extremely flexible, and people are now willing to take greater responsibility for themselves and to embrace greater social risk. Unable to implement urgent social reforms, governments have now withdrawn to a large extent from many areas that were once their responsibility. Numerous publicly owned companies have now been privatized. The population's flexibility and the trust placed in industry are paying off, creating greater opportunities for those looking for work or pursuing personal goals; however, this state of affairs also harbors considerably more risk for the individual.

Industry is the engine driving society. Europe is leveraging its lead in knowledge and expertise – primarily in product development, process management, productivity, and quality assurance – to compete successfully against recently industrialized nations like China. The importance of the services sector has increased enormously. The marketplace has ceased to be a mere agglomeration of domestic markets and has matured into a cross-border, global network. The fact that people are now living, working, thinking and learning in a heterogeneous network that is global rather than just pan-European in scope is beginning to play a crucial role in economic growth and the advancement of society.

One major factor driving this growth and advancement is society's willingness to embrace change and accept risk. People have come to recognize that self-responsibility is also empowering in that it creates greater latitude for shaping one's life and achieving self-fulfillment. However, a society marked by open competition and an absence of government regulation faces a deepening divide between those who belong and those who do not – a divide now evident in all areas of life. In terms of education, health care, the social and business spheres, lifestyles, mobility, and consumption, society is split into two classes. Those with

work and money can afford fully equipped homes, complete with multimedia technology and even security services. They can also afford first-rate health care and education, as well as upmarket clothing, vacations, and leisure activities. Those in the uppermost tier of society are part of an elite whose mindset and sphere of action are global. Social strata are more permeable than in the past, offering greater opportunities for the upwardly mobile; however, the risk of a fall from grace and loss of status is also greater than at any time previously.

People's greater latitude for shaping their lives is having an impact on the work and social environments. The ties that used to bind employees to employers can now no longer be taken for granted. Businesses need to respond flexibly to changes in markets and to make optimum use of resources, and many people are either turning this to their advantage or are struggling under the consequences: They change jobs more frequently, take on short-term work, and are more willing to acquire new knowledge and skills and to work in changing teams. Many do this without having any kind of fixed work location or cultural environment. Given the constant changes and fluctuations in the workforce, companies are going to great lengths to boost employees' commitment and to win the loyalty of the best and the brightest.

The general tendency to think in terms of networks is fuelling this process. Traditional social units like the family and circles of friends and work colleagues are gradually being supplanted by personal networks – convenience relationships with people encountered in certain walks of life with whom one chooses to maintain contact. These relationships may offer greater variety, but they are also less binding. Professional and private networks intermingle, and employers hire people partly on the strength of their networks of contacts. Everybody has their own network, but the quality of that network depends on the individual's degree of participation and the active attention he or she is willing to devote to it.

Increasingly, businesses too are forming networks to complete particular tasks or projects. This enables them to operate more flexibly and responsively than in the past, when greater importance was placed on formal ties and associations.

The personal freedom that people enjoy is creating a desire for the ability to network easily with others and for the kind of technical infrastructure to support that. One fundamental need, alongside mobility, is to be constantly reachable, both at work and outside of work. Those who want to stay ahead of the curve in their jobs and their private lives need constant access to the latest information and to be close to where the action is. The best way to achieve this is to leverage the potential of personal and company networks. Communication technology is feeding this need with a steady stream of innovations. E-commerce has advanced to become the most important sales channel. Countless daily-use objects are now “smart” and can network with one another to extend their functionality. This means that less effort is required from users to operate equipment, saving time and money that can be better spent on other activities. Here too, though, the problem of the divide is evident: Only those who can afford access to this kind of technology can benefit from the advantages it has to offer.

1 The Horizons2020 scenario

1.1 Focusing on the future

Europe's ability to remain focused on the future is key to its onward societal and economic development. Societies that hold optimistic expectations about the future are in a far better position to decide on critical issues effectively and to ensure that the solutions they choose serve them well, not just in the present but also in the intermediate term.

However, the present as it stands always holds not just one but many potential futures in store. Any debate regarding society is ultimately always also a debate about desirable futures and what can be done to help these come about. In essence, examining or pondering the future takes five different forms: visions, trends, forecasts, strategic scenarios and communications scenarios.

Visions express a future course of development wished for by an individual or group, a desired set of circumstances that requires efforts to be focused consistently in order to be achieved. Accordingly, a large number of corporations today now distinguish clearly between their vision and their mission, whereby the latter represents the actual initiatives that need to be taken in order to turn the vision into reality.

Trends are essentially processes of development that are rooted in the present and, as such, can be predicted to a large extent. This report, for example, spotlights a number of technology trends that we can expect to see emerge but may not become reality or useful to society by the year 2020.

This is where forecasts differ: They take a comprehensive range of identifiable factors into account so as to make statements as to when certain milestones in a process of development will be achieved and to quantify the extent to which developments will be utilized.

Trend tracking and forecasting both build on experts' knowledge and predictions in particular fields. Because the expertise that forecasts draw on is so specific, the perceptions of the future that they put forward are very much an inside perspective. The sections on technology trends in this report, for instance, were written by experts heading up important fields at Siemens – people who play a leading role within the global science and technology communities.

Scenarios differ fundamentally from forecasts in that they do not draw on statements from experts in specific fields. Instead, they home in on trends in other fields that exert an influence on a focal field of interest (say, emerging technologies). The first step with scenarios is to map out future patterns in population growth, the economy, and the political and judicial spheres. The second examines the consequential impact of these patterns on the focal field of interest. In this case, the perceptions of the future offer an outside perspective in which expert opinion from within the focal field hardly plays a role.

Scenarios differ additionally from all the aforementioned ways of examining the future in that they posit that the present harbors the potential for more than just one future. Compared to forecasts, which postulate a certain inevitability in future developments, scenarios support the view that people and societies can actively shape their tomorrows by choosing what kind of future they would like to see develop out of the present. Experience has shown that preparing two to three depictions of the future generally covers the breadth of inherent possibilities to a sufficient degree. Any more than two or three would be detrimental to the clarity of the ideas put forward, besides being difficult to absorb and process.

Scenarios come in two types, each with a distinct goal: The first, the strategic scenario, is designed to help companies and institutions anticipate future trends and developments. The conclusions and consequences drawn from this kind of scenario are relevant to organizations' internal structures, human resource capacity, and product and service offerings. By and large, strategic scenarios reflect quantifiable trends – such as faster or slower market growth in a particular sector.

The second, the communications scenario, serves to promote debate within society and encourage people to think about and discuss particular issues. With this kind of scenario, the point is not to quantify developments but to highlight the variety of possible futures rooted in the present. Communications scenarios are therefore used to prepare at least two depictions of the future that assume diametrically opposite courses of development in a particular area of life. This polarized view of the future is best suited to the context of public debate.

This report presents a communications scenario through which Siemens hopes not just to engage the general public in a dialogue about possible life worlds in the year 2020, but also to make a valuable contribution toward Europe's ability to act in a future-focused way.

For some time now, the future and innovation have been two priority issues for Siemens, and the company's ideas in this area have been the subject of publications like *Pictures of the Future*, a magazine on research and development, that presents scenarios spotlighting important technological advances. Whether or not these advances ultimately mark breakthroughs depends on social and economic factors, so the task of the scenario presented here is to put technological developments into a socioeconomic context and shed light on what life could be like in Europe in 2020.

This particular year was chosen as a time horizon because it is sufficiently close to allow precise predictions for the future and because it marks a time span in which industry and society cannot change so fundamentally that the ideas presented create the impression of being wishful or utopian thinking or entirely removed from reality.

1.2 The term “scenario”

The term “scenario” is used here to refer to systematically prepared descriptions of possible and probable futures. Borrowed from the language of the stage, it expresses an analogy. Like the set and scenery on a theater stage, which create a thematic context and general tenor for a particular scene, scenarios establish a general framework for different depictions of the future. The difference between science fiction and scenarios is that the latter map out a plausible string of developments that could lead to a given situation in the future.

Scenarios are not forecasts or predictions in a conventional sense; instead, they point to possible futures inherent in the present. Rather than assume that the future will follow one single course, they examine the breadth of possibilities surrounding influencing factors and arrive at many different portrayals of what the future might hold. By developing two opposite perceptions of the future, we hope to adequately represent the span of different possibilities. Ultimately, the most likely future probably lies somewhere between the two extremes presented here.

1.3 Horizons2020: Requirements and expectations

Credibility

The scenario had to be more than just a black-and-white snapshot of possible future trends and developments. For this reason, the traditional division on the lines of a positive, desirable picture and a negative, undesirable picture of the future was rejected. Instead, a new method was used in the scenario-building process to determine which developments would have the greatest positive effect on the future. An additional requirement was that the completed scenario should be readily comprehensible for a wide public audience.

Durability

The scenario had to be sufficiently general that it would not be impacted by events in the shorter term that might detract from its validity to a significant degree. Experience has shown that scenarios usually warrant a thorough review after a period of between three and five years to enable current events and issues to be taken into account and to bring the scenario up to date.

A Europe-wide frame of reference

The scenario was to address developments on a pan-European scale. As a result, Horizons2020 only distinguishes between its designated regions – the European economic heartland, Northern, Southern and Eastern Europe – in such instances where substantial differences exist.

An empirical foundation

The scenario was not to be based purely on secondary analysis conducted by a small think tank. Instead, it was to build on the knowledge and informed opinions of experts from all over Europe. With this goal in mind, an advisory board was formed, and the project team conducted a survey among a hundred or so experts around Europe.

A basis for public debate

The scenario was to provide a basis for discussions with various social groups surrounding their own perceptions of the future. Horizons2020 therefore seeks to emphasize the amount of latitude there is for shaping tomorrow's world.

Complexity

The scenario sets out to provide a detailed depiction of what life could be like in 2020. This has resulted in an examination of possible trends and developments on a breadth that is rare in communications scenarios of this kind. Since it was decided that the issues addressed should remain as clearly delineated as possible, the scenario presents brief sketches of key developments in individual areas rather than examining them in exhaustive detail.

1.4 Methodology: The scenario

The scenario in this report is a communications scenario that offers two distinct depictions of the future, each based on currently identifiable processes of development. It was created using a method of mapping environment scenarios originally developed by the Battelle Institute in the 1980s and later refined by TNS Infratest. The processes of development in various areas of life presented in the scenario are underpinned by a quantitative survey of expert opinions.

The aim of the communications scenario is to encourage creative debate and to offer a means of tying in the highly complex topic of life worlds in Europe in 2020 with Pictures of the Future and other scenarios for tomorrow's world prepared by Siemens. Thus, besides offering an abundance of ideas for public debate, this communications scenario puts technological developments in a political, social and economic contextual framework.

The first step in the scenario-building process was to define the field of study, in other words the focus of the scenario, namely life worlds in Europe in the year 2020. The aim was not to prepare forecasts for the field of study itself but to create two depictions of the future based on descriptions of developments in a number of different life areas.

The second step was to define those life areas that exert an influence on the life worlds. These five life areas were identified as relevant for Horizons2020:

- The political arena (government, international relations, the organized public, the media and information)
- Society (values, demographic developments, social structures, education, health and mobility)
- The economy (economic developments, the labor market, the corporate sector and management)
- The environment (environmental awareness, foods)

- Technology (general technological developments, power engineering, information and communication technology, and genetic, biological and medical engineering)

In a third step, the project team pooled ideas to define descriptors describing each of the life areas. These descriptors are qualitative or quantitative metrics describing developments using pairs of terms like faster/slower, greater/smaller, and increasing/decreasing. The team consulted with the advisory board to identify ten mega trends from an overall range of more than 200 descriptors, eventually selecting 108 descriptors for inclusion in the questionnaire submitted to the experts as part of the project survey. In the area of technology, descriptors were only included in cases where alternative developments were conceivable. The majority of technological advances through to 2020 are already identifiable in the present and foreseeable. These are presented in separate technology reports.

The fourth step involved distinguishing between critical descriptors (in other words descriptors that might follow different courses of development) and non-critical descriptors (those that would follow a clearly identifiable course of development). Both alternatives for each descriptor were presented as a basis for discussion in the survey conducted among experts. Of the 671 experts on societal issues, politics, culture, economics, and technology who were contacted, 116 elected to take part in the survey. In the initial round of the survey, 31 descriptors were identified for which each of the alternatives was selected by at least 40% of the experts and were therefore deemed to be critical, i.e., capable of following different courses of development. In those cases where one of a descriptor's alternatives was selected by fewer than 20% of the experts, that descriptor was rated as non-critical.

The experts were then polled on all of the other descriptors in a second round. This time, a further 41 descriptors succeeded in qualifying for inclusion in one of the two scenario depictions. In addition, the advisory board chose to add four more descriptors that it regarded as critical but the experts did not.

Descriptors

	Number	Non-critical	Critical
First advisory board meeting	200+		
Mega trends	10		
Round 1 of expert survey	108		
Descriptors rated as critical			31
Descriptors rated as non-critical		15	
Round 2 of expert survey	62		
Descriptors rated as critical			41
Rated as critical by advisory board			4
Descriptors rated as non-critical		17	
Total descriptors		32	76

In a fifth step, two consistent descriptor lists were created from the pool of 76 critical descriptors identified. These lists provided the basis for two sets of life-area descriptions.

The project team used the reciprocity of the descriptor alternatives submitted to the experts to verify the consistency of these descriptor lists. This reciprocity was computed using consistency software. The first step consisted of pooling all of the positive attributes in one possible scenario and all of the negative attributes in another. The goal, though, was to prepare two separate scenarios that each contained negative as well as positive courses of development. By correlating all of the alternatives for critical descriptors with an optimism index for the future (an innovation in scenario-building techniques), the team determined which courses of development had the potential to shape the future in a positive way.

Thirty-eight separate alternatives were identified as having a positive impact on the future. By creating scenario subsets, the team succeeded in mapping out two depictions of the future, one centered on 20 positive alternatives, the other on 18. They also made three key adjustments:

- Positive developments in the economy and in the political arena were divorced from one another and each assigned to a different depiction of the future.
- Major advances in high-profile technologies were combined with a positive course of development in the political arena and assigned to just one of the two depictions.
- The development of mass-market technologies was combined with positive economic developments and assigned to just one of the two depictions.

In a sixth step, the team prepared life-area descriptions based on these lists of descriptors for the two alternative depictions of the future and presented these descriptions to the advisory council for validation.

Step 7 consisted of preparing descriptions of the consequences and implications for life worlds in Europe in 2020 based on the life-area descriptions. To this end, two repositories were set up to pool ideas for life worlds – one for each of the two depictions of the future. These idea repositories, too, were reviewed and expanded in collaboration with the advisory board, and later provided the foundations for the two separate snapshots of the future presented here.

The project team then went on to determine the extent to which the scenario would remain legitimate if certain trends were to break (another issue discussed with the advisory board). Lastly, it verified the consistency of the life-area descriptions.

1.5 Methodology: The expert survey

To put the scenario on an empirical footing, a two-stage survey was conducted throughout Europe in which experts in a variety of fields of knowledge were asked to give their opinion on what life might be like in the year 2020.

The advisory board, Siemens (the client contracting the survey), and the TNS Infratest project team worked together to identify and select experts in the fields of economics, politics, society, culture and technology whom they could approach for their opinions on a number of different topics. Of the 671 experts contacted, 116 responded (71 in Europe's heartland, 16 in Southern Europe, 9 in Northern Europe and 20 in Eastern Europe).

In the initial round of the survey, the experts were not just asked to rate the various descriptors, they were also posed four questions chosen to gauge their degree of optimism regarding the future. Their responses were combined to create a so-called optimism index. As described earlier, the first and second rounds of the survey served to group the descriptors into critical and non-critical categories. Thanks to the expert survey, it was possible to evaluate the descriptors far more objectively and from a pan-European perspective than would have been the case had the project team or the advisory board merely done so on its own. This provided an important counterweight to prevent the subjective or one-sided categorization of each descriptor as either critical or non-critical.

In addition, the experts were able to comment on every individual topic if they wished. The respondents made active use of this opportunity, submitting more than 400 comments and remarks that helped extend the project team's understanding of possible alternative courses of development in Europe's various regions.

1.6 The regions covered

For the purposes of the Horizons2020 scenario, the project team defined four essentially homogeneous socioeconomic regions in Europe. The extents of these regions do not necessarily follow national boundaries.



Europe's economic heartland consists of these countries and Central European regions: Germany, Benelux, Austria, Switzerland, eastern and central France (including Paris and Toulouse), England (including London and Manchester) but not Wales or Scotland, the Czech Republic as far as Prague, the north of Italy (including Milan and Venice) and the area around Barcelona.

Northern Europe consists of the Scandinavian countries, Iceland, Ireland, and Great Britain (not including the southeast, which, as noted above, belongs to Europe's economic heartland), and the west of France.

Southern Europe encompasses Portugal, Spain (excluding Barcelona), central and southern Italy, Greece, Cyprus, Malta and the European part of Turkey.

Eastern Europe comprises the new member states that joined the European Union on May 1, 2004 (except for Cyprus and Malta), the eastern part of the Czech Republic, the Balkans in their entirety and the remaining countries in the east of Europe.

As at the start of the century, Eastern Europe consists of two regions: first, those countries that joined the EU on May 1, 2004, Bulgaria and Romania (two candidates for EU membership), and the Balkans; and second, those countries further to the east, including Russia.

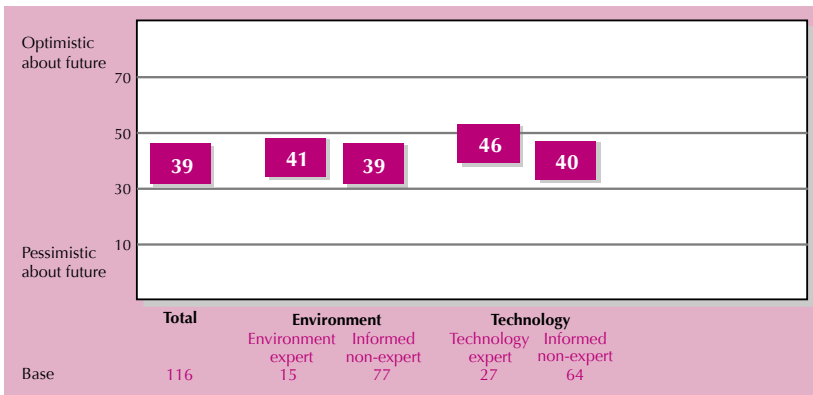
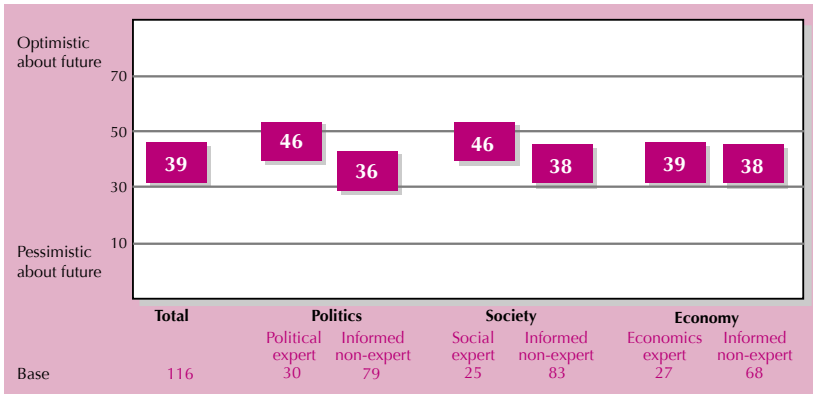
In consultation with the advisory board, the project team elected to assign Slovenia and the Baltic states to Eastern Europe on account of their low GNP.

1.7 The optimism index

The survey conducted among experts also marked an opportunity to gauge certain courses of development in quantitative terms. On the basis of responses to the four questions posed concerning general living conditions, the economic situation, cultural life, and the social climate in Europe in 2020, an index was created that reflects the degree of optimism in societies regarding the future. Thirty-eight percent of the respondents stated that they expected living conditions in Europe in 2020 to be either excellent or very good, whereas just 16% and 7%, respectively, were as optimistic about the economic situation and the social climate. By contrast, 56% of the experts were of the opinion that Europe would have a vibrant cultural life in 2020.

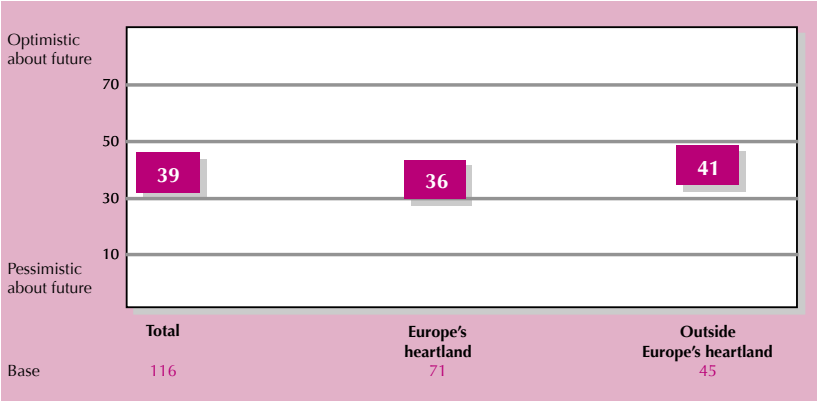
Using the results obtained, an optimism index score of 39 was computed for the fall of 2003. It is interesting to note that the experts in politics, technology, and societal issues produced an index score of 46 – much higher than those of the economics and environmental experts, which came in at 41 and 39, respectively. In the first three fields, accredited experts show a far higher index score than those with just an informed opinion. This would indicate that those involved more intimately with one of the named fields tend to have a more optimistic view of the future than those involved to a lesser degree.

The experts' optimism index



What is also striking is that the experts in Europe's economic heartland hold a more negative view regarding the future than their counterparts in other regions. This is possibly attributable to the fact that the fear of the loss of might is more pronounced in Europe's heartland than elsewhere. Interestingly, experts in Northern Europe are the most upbeat about Europe's future.

The regional optimism index



Using this optimism index, the project team went on to calculate which developments (in the experts’ opinion) would have the greatest positive influence on expectations regarding the future. In the first of the two depictions of the future, developments in the political arena – in particular, the ability of governments to move ahead with fundamental reforms and to create a new economic order in which the principles of a market economy and equal opportunity dominate – are primarily responsible for a positive future. In the second depiction, globalized industry, an openness toward change in society and new solutions to strengthen Europe as a business and industrial location offer grounds for an optimistic assessment of the future.

2 Scenario 1 – Life in the year 2020

2.1 General situation

2.1.1 Politics

In the year 2020, globalization has made further progress and Europe has become deeply integrated with other economic areas, countries and international communities.

In 2020, Europe is a construct that comprises Romania, Bulgaria, Turkey and most of the Balkan countries in addition to the 25 earlier member states of the EU. Close special relationships are maintained with Belarus, Moldova, the Ukraine and, above all, Russia. The same goes for the North African countries that line the south coast of the Mediterranean and, to a lesser extent, the Caucasus states. With 35 members, Europe is still something of a “work in progress” in 2020. Yet the path to a unified Europe has been clearly charted and is welcomed by the majority of its citizens.

This community of states has its own representative institutions – including a European foreign minister, the European Parliament and the European Court, for example – but still rests on the foundation of the nation state. On many issues, however, individual countries follow the majority opinion of the community as a whole. The collective aim is to go beyond a shared economic area and create a single European society. Built on the bedrock of a common Western heritage and culture, a Europe has emerged that acts in concert and (by and large) speaks with one voice. At the same time, its member states express their autonomy in such areas as their economic capabilities and the design of their social systems.

In 2020, governments are reluctant to leave major infrastructural challenges such as education, health care and the water supply to the whims of the market. Regulatory intervention is therefore commonplace and has paved the way

Scenario 1 – General situation – Politics

to comparatively “big government” all over Europe. In this area, governments do not restrict themselves to an active structural policy but also pursue active economic policies.

Thanks to strong government and close international collaboration, crime and terrorism have been battled successfully and reined in on both a national and an international level. Europe’s close cooperation with the USA (the one global superpower) and its allies, China and India, has proved singularly useful in this context. Governments’ monopoly of political power is unquestioned; and this has established a stable legal framework that protects people from crime. All citizens enjoy equality before the law throughout Europe. Generally valid legal systems are also enforced.

From a regional context up to the pan-European level, government institutions are clearly structured. The people of Europe know what gets decided where and which authorities are responsible.

In the years leading up to 2020, the political establishment has found robust, workable reforms to respond to the key economic and social challenges of the 21st century. Reforms in recent years have resolved the fundamental problems surrounding pension provision and health care. Popular confidence in the long-term sustainability of the pension and health care systems has been restored. Such political success stories have likewise rekindled trust that the political arena is indeed capable of finding viable solutions to pressing social issues.

Possibly the most successful reform of all – seen in the context of a globalized world – has been the striking of a new balance between individual incentives on the one hand and, on the other, individual social responsibility coupled with a more equitable society in general. This reform has indeed proved to be the cornerstone of a united Europe.

To even up the regional spread of prosperity, the economically stronger countries of Northern Europe and Europe’s economic heartland effect transfer payments to the countries of Southern, Central and (above all) Eastern Europe. Europe’s

economic independence is leading to close trading relationships with the Free Trade Area of the Americas (FTAA) and the Asian free trade area, to which China, Japan and Korea now also belong. At the same time, these economic areas often compete with each other. Governments have not been the sole agents of change, however. Political parties, trade unions and industry associations have also demonstrated their ability to reform by adapting their agendas and service offerings. This has helped them attract new members, establish an international footprint and so assume a seminal, formative role in politics and society.

In 2020, political parties play a key role in shaping the political will, and that from a regional to a Europe-wide level. The spectrum of parties has become very similar all over Europe. Having started out with a strong base in Europe's economic heartland and in Northern Europe, parties with an environmental focus are now also gaining a stronger foothold in the flourishing countries of Southern and Eastern Europe.

Most European countries have two conservative parties or movements, the one adopting a more popular, centrist position while the other, smaller party tends more toward nationalism. The latter groups are frequently in the news: Whenever nationalistic parties gain seats in parliaments, this is perceived as a threat to the social market economic order that has been revived and adapted to the age of globalization.

The liberal parties regard the middle and upper classes as their constituency. Advocating liberal ideas, they maintain a very close affinity to the self-employed professions and business associations.

Left of center, the political spectrum comprises three major blocks: a social-democratic grouping that gravitates more toward the center ground; a stronger socialist group that repeatedly does well in elections (especially in Eastern Europe) and has its roots in the formerly reform-oriented forces of Socialist Eastern Europe; and a left-wing socialist party that also contains radical elements. The latter defines itself primarily by its opposition to the right-wing parties and, in some cases, plays a significant role.

Scenario 1 – General situation – Politics

There are also parties with a strictly national focus. These organizations tend to represent specific economic groups or pursue narrowly defined objectives. Examples include a farmers' party, an education party and a "health care for all" party. Representative democracy has grown more important as the party political landscape has gained new strength. Attempts to bring together divergent social forces within a heterogeneous Europe have been successful.

As a result, grass-roots movements such as local pressure groups and non-governmental organizations (NGOs) now wield less influence in the political decision-making process. The established parties are generally very quick to co-opt political ideas that originate from these sources. Grass-roots institutions thus have a very limited sphere of influence, while the political parties effectively maintain sole jurisdiction over key issues.

The trade unions have astutely leveraged society's strong leanings toward intermediary institutions. Like the political parties themselves, they have been sufficiently adaptive to successfully defend their role in society. They have recruited large numbers of new members, above all in newly emerging service industries. The increasingly international focus of modern society has enabled them to exercise an important influence both in the political arena (across virtually all political hues) and on global corporations. Together with industry associations, unions today are instrumental in ordering the world of work even beyond national borders. Industry associations also play a pivotal role in establishing industrial and economic standards, preparing international treaties, and encouraging dialogue and knowledge-sharing between corporate players.

As in the past, the media still operates as a watchdog that seeks to influence the actions of governments and intermediary organizations. On the whole, the media landscape is very diverse, reflecting a fair balance of public-law institutions and private enterprise. Trade associations, unions, political parties and even the churches (whose influence has generally waned) throw their weight behind public media institutions in order to defend diversity of opinion. Their supervisory function in the relevant bodies and committees allows them to monitor media

companies' compliance with their mandates and legal duties. These institutions also use their influence in society to ensure that the media remain solidly financed.

The media landscape reflects a broad spectrum of opinion. Political commentary is kept separate from the delivery of content and information. Freedom of the press is now guaranteed throughout Europe and has given a boost to the whole of the media industry. The press has the right to protect its sources. Legal proceedings against it are subject to very tight restrictions. In addition, the media has benefited from copyright laws that recognize its pivotal role in the dissemination of ideas and content.

Patent protection has evolved along the same lines as copyright law and now affords international protection to inventions. This legal protection has enabled agents and the owners of copyrights and patents to continue to earn money from their intellectual property. Media companies also fulfill an important function on the World Wide Web, providing edited content in return for a fee. The Web nevertheless remains a vast hub of all kinds of information and still gives everyone the freedom to air their views. It also facilitates communication with companies and private individuals around the world.

2.1.2 The economy

Governments and the political arena in general influence the economy to a considerable extent. This fact, coupled with the power wielded by intermediary institutions, has given rise to a clear regulatory framework for economic activity. Economic growth in Europe is weak and follows an irregular pattern. Although every effort has been made to harmonize living standards across the continent, low growth has prevented GDP from even broadly converging across individual countries. Wage differentials can still be exploited as the labor forces in different parts of Europe specialize in different activities. In Eastern Europe in particular, wage levels remain below those of other European countries.

Scenario 1 – General situation – The economy

Europe's economic heartland and Northern Europe focus primarily on cultivating knowledge, trading, and providing auxiliary services. These regions have thus assumed a far stronger bias toward the tertiary sector than ever before. Information processing in particular is experiencing explosive growth. Capital and other engineered goods (such as vehicles and machinery) are assembled in these regions too. Most intermediate products – including very high-quality products that are finished in the European heartland and then exported all over the world – are manufactured in Central Europe or outside Europe.

Southern Europe and parts of Northern Europe serve as venues for recreation and leisure. Many people own second homes in these regions. This trend has encouraged new service offerings to spring up in rural resorts, causing the tertiary sector to gain ground and effectively hindering a rural exodus. It is also helping to bring greater economic balance to the various regions of Europe.

Nevertheless, Europe's efforts to compete in the global arena with newly established economic areas – notably China as a production location and India as a service hub – have met with only partial success. The past 15 years have seen what used to be a heavily industrialized continent evolve into a society whose economic mainstay is trade and the provision of services.

Ever greater expenditure on private health insurance, education and transport is eroding private households' disposable income. People therefore have less money to spend on private consumption and leisure activities. Not even the growing proportion of wealthy senior citizens in most European societies is able to reverse this trend. As a result, private demand for new, intelligent services is necessarily limited. What demand there is tends rather to be channeled into low-cost do-it-yourself services.

Declining private consumption is forcing companies to concentrate on developing value-for-money products and services. This development has fueled extensive consolidation in the corporate sector. The numerous global players that have emerged from this process now operate in markets that are oligopolistic in nature but still fiercely competitive. At the same time, it is easier for small and

medium-sized enterprises (SMEs) than for global corporations to service niche markets. The number of SMEs is therefore also increasing constantly.

Labor markets are far more flexible than they were 20 years ago, although governments have still not completely kicked the regulatory habit. A wide variety of work time models are now in operation. In addition, demographic trends have made it necessary to raise the retirement age. Some sections of the population welcome this development, as longer life expectancy and generally better health in old age now make it attractive for them to work longer.

For many people, however, extending their working life is simply a matter of economic necessity.

Many families and households have long been unable to survive on one income alone. Models involving second and third jobs have therefore emerged alongside double-income constellations to allow families to earn a reasonable living. Large numbers of people also tap the black economy as an additional source of income. Mainly due to the heavy burden of taxes and non-wage labor costs, governments have failed in their attempts to criminalize and thereby inhibit the growth of the black economy.

In the corporate sector, proactive innovation management has become a critical factor of success. Now that patent protection is working well, it pays to invest heavily in research and development. Competition for the position of innovation leader is keen and – thanks to brisk global demand for new products and services – usually also very profitable. This is true not only of products that have a long life cycle, but also of consumables and services. As a result, customized products can be sold at affordable prices.

Companies commit themselves to upholding society's values. Strongly oriented toward sustainability, they also pursue ecological and social objectives, shouldering their intergenerational responsibility as good corporate citizens.

2.1.3 Environment and infrastructure

Besides seeking to build a framework for a healthy society and vibrant economy, governments focus above all on efforts to conserve the environment and maintain a high-quality infrastructure. They also pay considerable attention to the issue of education, which is regarded as one of society's most valuable assets. No-one now questions the principle of life-long learning. Both public and private spending on education has risen accordingly.

The definition of educational objectives is still influenced to a large degree by national governments. Countries have, however, become more willing to acknowledge and accept each other's education systems. The mutual recognition of educational achievements and the more homogeneous international education market to which this has led are part of the firm foundation on which Europe stands today. Everyone who wants access to higher or further education now also has the opportunity to do so.

After education, health care has also become one of the most important issues – and in many cases even a status symbol – in today's ageing society. People are evidently willing to devote a large proportion of their income and personal wealth to health care. The state sees health care as a common good to which everyone is entitled, so it intervenes in the marketplace to create suitable conditions. Governments have thus defined a strict canon of medical treatments and methods that are publicly recognized and are available to all citizens.

Governments subsidize research into health care primarily in line with perceived social imperatives, i.e. in relation to widespread diseases. In the past 15 years, intensive and controversial discussions have raged surrounding the use of biotechnology in health care. This debate has brought forth a clear, consistent ethical consensus on accepted areas of application. In prenatal diagnostics, the right to have healthy children is still hotly disputed. Conventional wisdom currently agrees that this principle should only be applied in the case of very serious conditions and handicaps. Pan-European laws and directives have been

Scenario 1 – General situation – Environment and infrastructure

ratified to this end. Stem-cell surgery is still waiting to make the breakthrough. It will probably be another 20 years before this discipline becomes established on a broad front.

Since governments attach primary importance to education and health care, substantial public funds flow into these key areas of infrastructure. On the other hand, the state is scaling back its investments in the transport network, more and more of which is being entrusted to private enterprise.

Toll systems and funds today provide private financing for many roads and rail networks. This has considerably eased the strain on public coffers, giving governments leeway to invest on a large scale in education and health care. With mobility still at a premium, however, private households now also spend more to get around.

It is now widely understood that the state of the environment has serious implications for the quality of life in general. Accordingly, governments are taking steps to combat or prevent climatic change, for instance. Society as a whole has risen to its intergenerational responsibility with regard to the consumption of resources and protection of the environment. Individuals are therefore willing to accept restrictions that promise to keep the world in good order for future generations. In the corporate sector, the development of a method of calculating the impact of sustainable management has done a lot to encourage firms to tackle problems that can only be resolved across several generations. Such forward-looking environment management policies have ensured that sufficient resources remain available even though global consumption has increased. In addition, new reserves of natural resources have been tapped and more and more alternative technologies are now being used.

World population growth has also necessitated forward-looking management of global food supplies. This is just one area in which companies are making greater use of new technologies. Consumers these days prefer natural and organic foods, for which they are also prepared to pay a premium. The political echelons and the farm industry make sure that no artificial fertilizers or pesti-

Scenario 1 – General situation – Technology

cides find their way into the food cycle. And laws and ordinances have combined with consumers' keener awareness of food quality issues to help reduce soil pollution.

Water remains one resource that can only be owned privately subject to a raft of conditions and constraints. Many European countries still oppose the privatization of water. This, however, inhibits the use of private funding for major and necessary investments in the water industry, as well as making it more difficult to deregulate water utilities.

The widespread introduction of fuel cells – not least with the aid of sizeable subsidies – has cleared the way to serious attempts to decarbonize road traffic. Stationary applications of fuel cell technology are already well established, mostly in residential estates and industrial complexes.

The interconnected power grids in place across large swathes of Europe facilitate the ideal combination of central power plants and distributed power generation facilities. Extensions have been granted on the moratoriums that should already be taking nuclear power plants off the grid in some European countries. The threat of major nuclear accidents, growing fears of terrorist attacks on nuclear reactors, and concerns that terrorists or even countries with no stable legal system might gain access to fissile materials caused Europe to sign a declaration that it will dispense with nuclear energy entirely as of the year 2040. The assumption is that, in an increasingly high-tech society, alternative technologies will be able to meet growing demand for energy.

2.1.4 Technology

Today's society is very open to new technologies. Since governments agreed to shoulder liability for large-scale risks, businesses have become much more willing to invest in innovative development.

The clearly defined role of the regulators who closely monitor the markets for transportation, power and telecommunications services likewise helps these industries to maintain price levels that permit further technological progress.

In the field of mobile broadband technology, attractive mobile services for corporate and retail users have been rolled out successfully. The spread of electronic entertainment has created a situation in which “virtual reality” is an important aspect of life for many people, especially for youngsters. Some people – especially those who feel that everyday life has become devoid of meaning – even use such developments to cut themselves off from the real world. The Internet has become literally omnipresent, fueling a spectacular boom in electronic entertainment and electronic commerce.

Experience in logistics and copious investment in logistics systems have enabled stationary retail firms to stand up to e-commerce. The majority of daily necessities are therefore still bought and sold in bricks-and-mortar stores.

Automatic translation systems have established a broad base for themselves. As a result, even regional languages such as Catalan and Ladin have been kept alive. English has nevertheless extended its dominance as the international lingua franca.

Concerned about perceived threats to their privacy, people are still extremely wary of ubiquitous computing. Because of the extra effort that would be needed to protect privacy, it is still not economically viable to network household appliances. Conversely, the war on terrorism and the need for greater security have opened the door to wider acceptance of new surveillance and personal identification technologies.

Government backing for technological development and the requirement for vast computing power in security applications have facilitated a major breakthrough in quantum computing, opening up completely new possibilities for industry. Parallel computing has now become commonplace.

Scenario 1 – General situation – Technology

Political interests have ensured that most computer networks remain centrally managed. One aim is to ensure that networks provide full national coverage. Another aim, however, is to enable state monitoring of these networks for security reasons, i.e. to make it easier to intercept criminals and (potential) terrorists and to track down hackers.

The singular importance of electronic communication and electronic media, coupled with government efforts to promote communication technology, has prevented the emergence of a “digital divide.” Essentially, this danger has been warded off by equal opportunities in education and the guarantee of access for everyone to the various educational institutions. By consequence, almost everybody today uses new technologies, although private households have limited budgets for this item.

Intelligent autonomous systems have become widespread only in the corporate sector, where they are used to forecast financial data, optimize investments and manage traffic flows. Partly due to the erosion of disposable income, they have so far had no significant impact on the private household segment. In the food processing industry, governments have passed laws and regulations requiring genetically modified (GM) foods to be clearly labeled as such. This has helped ensure that non-GM food is still available. Even so, GM foods have slowly but surely been making inroads, although environmentally aware consumers remain very skeptical.

Europe scored a major political success when it ratified uniform legislation regarding the use of genetic engineering, an area in which it also cleared up the issue of ethical permissibility. This advance gave the industry a reliable legal framework within which to operate, as well as guaranteeing a level playing field across the whole of Europe. So far, however, Europe has not been able to export these principles beyond its own borders. Free from relevant legal constraints, both the USA and a number of Asian countries have secured a competitive edge in all three segments of genetic engineering: green (agriculture), red (medicine) and gray (microbiology and environmental technology). Many international corporations thus currently operate a dual strategy. On the one hand, they man-

ufacture products in compliance with European directives. The resultant high standard of quality means that these products can also be sold outside Europe. On the other hand, they also make products that do not meet the stringent European norms and can therefore only be produced and sold outside Europe.

In light of Europe's consensus on fundamental ethical principles, the use of genetic engineering techniques in relation to human or animal life is handled very restrictively. No patent protection is granted for inventions in this field – a circumstance that has sparked numerous international disputes.

2.1.5 Social values

Traditional conservative values remain central to European society. Social responsibility, tolerance and a clear concept of morality underpin all forms of social interaction. Each individual is responsible for their environment, their own life, their personal development and their actions. Values such as fairness, consideration and responsible behavior are the yardstick by which companies, organizations and individual people alike are measured. These values line up with the tremendous importance attached to one's career and to the principle of life-long learning, which is regarded as important to one's social standing.

As a status symbol, consumption has all but withered and died. People from all social strata, be they rich or poor, are cost-conscious about what they buy. Discounters have reinforced their market position as a result.

Over the past 15 years, security has taken on a new social significance. Governments have been reasonably successful in protecting the safety of their people. In return, the latter have largely accepted controls and surveillance where these are seen to enhance security. Considerable importance is nevertheless still attached to the protection of privacy and hence to data protection. All forms of surveillance that violate this principle are flatly rejected.

Scenario 1 – General situation – Demographics and social structures

Some sections of the population are skeptical about globalization. Values have gradually been changing as society becomes an increasingly multicultural mix of diverse lifestyles. Among those groups that have not benefited from globalization, this trend nourishes fears and anxieties rather than fostering a cosmopolitan outlook. The groups concerned therefore tend to cling more strongly to what they know and understand. One consequence of this is that national and regional languages such as Basque and Breton are experiencing a renaissance even while English asserts its predominance.

2.1.6 Demographics and social structures

Society has experienced fundamental changes in the past 20 years. Today, older and in many cases affluent people wield considerable social influence. Not least owing to the small share of the total population for which they account, children are valued especially, as is the family. People increasingly feel a sense of responsibility toward future generations. As society has thus become more oriented toward the needs of children, governments have set up sufficient childcare facilities to enable people to successfully reconcile career and family life in all European countries. This development has radically altered the role of women, whose influence in the business and political arenas has increased sharply.

Europe has managed to keep the income gap between rich and poor within reasonable limits. Social welfare systems provide basic social insurance coverage for everyone. However, the contributions needed to fund this system are one reason why people have less disposable income.

Despite limited incomes and the progressive convergence of living standards in the different parts of Europe, the continent's economic heartland in particular remains a popular destination for non-European immigrants. This fact has added prejudices against such immigrants to people's existing reservations about globalization.

Scenario 1 – General situation – Demographics and social structures

Intensive labor specialization in the various regions of Europe has prevented the spread of prosperity from becoming completely homogeneous across the continent. Parts of Southern and (above all) Eastern Europe continue to lag far behind the trend for Europe as a whole. However, growth in the number of pensioners has effectively revitalized rural areas, which are now popular vacation resorts and venues for retirement. This development has effectively halted the growing trend toward urbanization.

2.2 Life in the year 2020

2.2.1 Lifestyle

2.2.1.1 The modest society

Society has become more modest in its expectations. It has been forced to realize that there is a limit to economic growth. Although the income people earn is still growing in nominal terms, many people have seen their purchasing power dwindle, at least in the area of private consumption. One of the main reasons is that social welfare benefits have been rolled back. People now have to pay out of their own pocket for many of the services that governments used to provide free of charge. This is true of health care, education and, in particular, mobility. However, since everyone is affected more or less to the same degree, people have had little choice but to come to terms with the resultant restrictions.

Economic growth in Eastern Europe is plotting a different graph: After heavy initial losses precipitated by the transformation from planned to market economies, purchasing power has risen slowly but surely.

Europe has successfully prevented the gap between rich and poor from becoming inordinately wide. In the various countries of Europe, the minimum wage is still over half the average income of the entire population. Similarly, a comparison of the 35 countries that now make up the European Union shows that purchasing power in those countries where wages are lowest is close to 50% of average purchasing power for the continent as a whole. Furthermore, it is likely that the 50% barrier will be overcome in the foreseeable future. The aim is to achieve an “equitable level” of between 50 and 65% in order to keep society generally content while still providing sufficient room for performance incentives in the form of pay differentials.

The desire to realize this equitable level also played a central role in the design of social welfare reforms. In 2020, everyone has the right to a reasonable pen-

sion – i.e. one that meets their basic needs – plus a defined catalogue of basic health care and education services. European pensioners today receive pensions equivalent to between 50 and 60% of what they earned on average during their working life. Although systems do vary from country to country, they are all posited on the same conceptual framework.

To exercise a positive influence on the way people perceive their lives, today's governments offer their citizens what a commission in the UK toward the end of the past century identified as the objectives of the state:

- Equity
- Modest prosperity
- Political stability, order, justice and the rule of law
- Health care
- Work and Employment, not just transferred income
- Democracy

2.2.1.2 The attraction of a slower pace

The emergence of a “new modesty” has been accompanied by another social paradigm shift: The fast-track society has rediscovered the joys of “coasting.” Both at work and at home, the pace of life – at least in Western Europe – is gradually slowing down. Although people work longer hours, they no longer do so under such extreme stress. The reality that people who are less hassled are often more creative, more productive and healthier cannot be overlooked.

The wide gulf that separates high performers who are exposed to all kinds of stresses and strains from the remainder of the workforce is gradually beginning to narrow. Speed is becoming less important as the quality of life and the quality of the individual's work and activity take on greater significance. People are rediscovering the art of sensory enjoyment, consciously taking the time to sharpen their sense of smell, taste and touch.

Scenario 1 – Life in the year 2020 – Lifestyle

Toward the end of the past century, J. F. Steiner came up with what is called the “semiometry model,” which is used in social research to model a culture’s prevalent values or perceptions. In marketing, the same method is used to define target groups.

A space is marked out whose boundaries are “duty” and “pleasure” along one axis and “community” and “autonomy” along the other. 210 different terms are spread over this space. Respondents are then asked to score each term on a scale from “very unpleasant” to “very pleasant.” By analyzing the results, it is possible to draw conclusions about the current values and perceptions of a society. The terms used as a society’s value indicators are themselves the result of a two-phase research process that began with the in-depth analysis of literature (such as the Bible, for example) that has had a lasting influence on European culture.

In phase two, a multilevel empirical factor analysis condensed the words produced by phase one into the 210 terms that are now used in the discipline of semiometry.

The foundation on which to interpret social developments was laid by comprehensive questionnaires performed in Europe between 2001 and 2003. In these questionnaires, terms such as peace, friendship, family, loyalty, to recover and to laugh were at the top of the list. These terms were grouped around the community axis, an indication that they described the prevalent focus of social values at this time. Today, a repeat survey finds that top priority is now given to terms such as birth, ocean, together, voluptuous, feminine and to dream. These terms are found in close proximity to the pleasure axis. They thus reflect the prevalent life experience, which is partly the result of a fair balance between work and private life (see figure on page 35).

2.2.1.3 From the age gap to generational integration

The share of the population made up of older people grew ever larger at the start of the 21st century. It is now some time since the conventional model of learning in one's youth, working in adulthood and enjoying well-earned freedom and leisure in old age was overtaken by a changing reality. Today, people in all three phases of life want and indeed have to strike a balance between learning, working and enjoying their free time. As a result, people of all ages now enjoy a far healthier balance between life at work and at home. The gradual deceleration of life has made a major contribution to this trend. People are thus generally happier, as well as being more interested in exploring the meaning of life rather than just "climbing the career ladder." The fact of mortality, long suppressed by the hustle and bustle of everyday life, is now much closer to the surface of the individual's consciousness, despite the fact that people now live longer and only see their bodies and minds beginning to falter much later.

2.2.2 Old age

2.2.2.1 The gray society

A new chapter in world history is about to begin. Never before has the world known a society in which people over the age of 60 accounted for almost a third of the entire population. Very soon, however, this will be the case in a number of European regions. On average, almost every fourth European citizen is over 60 in 2020. In past history, the aged only ever represented a tiny minority.

The speed and energy of youth is now giving way to the wisdom of age as the driving force in society. This wisdom expresses itself in several forms: a detailed factual knowledge about life's fundamental questions (experience); strategic knowledge (how do I take good decisions, who should I ask, how do I evaluate information?); an understanding of how different aspects of social life interrelate; a consciousness of the uncertainties of life (alternative mindsets); tolerance; and a grasp of the relative nature of values and life goals.

This does not mean that today's "gray society" feels its age, however. As people grow older, perceived age is increasingly defying the testimony of the calendar. Today's seventy-year-olds feel more like they are in their mid-fifties. Physical capabilities still diminish, but at a far slower rate than in the past. Yet the older generation retains a very impressive mental agility. People have realized that, if they continue to train their brain, learning really can be a life-long experience.

Today, old age itself is subdivided into two distinct phases. In the first phase, which on average continues until people are in their mid-eighties or approaching ninety, older people can reap all the benefits of experience coupled with a healthy mind in a healthy body. They are generally just as happy and content in this initial phase as younger people. It is nevertheless followed by a phase of limitation as the body begins to weaken and the risk of various forms of dementia increases. Older people's use of all kinds of wellness facilities has combined with longer active involvement in professional and public life to significantly push back the boundary between these two phases of life – a trend that is still intact. Medical advances, too, have been instrumental in supporting this development. Preventive medicine and ongoing medication have taken much of the terror out of a whole series of diseases, such as hypertension, diabetes and several types of cancer.

2.2.2.2 The role of the aged in shaping the present

Society is keen to woo the favors of old people. The business community sees them as a growing, financially independent target group, albeit one that is not given to excessive consumption. The political arena benefits from their voluntary activities. And families look to them for assistance in raising children and walking them through their formative years.

Older people thus act as family mentors. In many cases, however, they perform a similar role for companies and public institutions too, advising or helping out in labor-intensive service areas. They provide nursing care in the social sector, go out "on the beat" to improve security, lecture as senior professors at universities, and are much in demand as consultants for the corporate sector. All these

services are provided in return for a token consideration or in a voluntary capacity. In many cases, this income is a welcome boost to low pensions.

The greatest advantage of these “young-at-heart” old people is that they are geographically mobile and have flexible time schedules. They are not bound by all the restrictions experienced by those who must feed a family and look after the children. The aged therefore visit schools and universities for life-long learning, establish learning networks (in areas of shared interests, for example) and learn in the same way youngsters will do when they begin their careers.

In their free time, many old people devote their time to public office, party politics and trade union activities. They hold voluntary positions and bring welcome diversity to clubs and associations.

2.2.2.3 The final phase of life

Had the ageing of European society not been accompanied by a declining birth rate, the population of most countries in Europe would have grown substantially. This would have overburdened the social infrastructure. Way back in the 1990s, it was already becoming apparent that spending the last years of one's life in a care home is barely affordable. As a result, all forms of hospitalization and the further spread of hospices have been severely restricted.

Today, the more youthful of the older generation do their bit to ease the shortage of nursing staff. They look after sick people on a voluntary basis or in return for low pay and ensure that those in need of care always have someone to talk to. A combination of technology and household help aids them in this task. Many of the latter still pay no social insurance. And, since they often have no work permits, they earn very little. Biomedical sensors help nurses to recognize when a doctor needs to be called in. Technology-assisted home surveillance allows even those who need constant care to enjoy at least a measure of independence (see also section 2.2.10, Health care).

The jury is still out on the issue of whether people have the right to determine the time of their own death, or whether relatives and friends can make such decisions. Doctors are dedicated to saving and preserving human life. Yet this often leads to situations where people have to live in nursing homes, because the degree of care they need would be too difficult to provide at home. Society is still hotly debating both the ethical and the economic aspects of the right to die.

2.2.3 The family

2.2.3.1 Parents

People today practice more different forms of “cohabitation” than ever. The family often used to be the nest in which both parents and children felt secure. They ate, slept and spent their free time together. While this constellation still exists, there are far more “club families” these days. Planned events are what bring these families together. Beyond that, each member goes their own way. The number of families whose members remain constant over time is decreasing all the time as people frequently change partners. Patchwork families, short-term partners and a host of single-parent families are some of the more common variations on this theme. The desire to have children is nevertheless re-emerging.

Society as a whole has become more accommodating toward children. Governments and the business community have had a hand in this: Child benefit allowance, day nurseries that stay open until late in the evenings, and the chance to recruit household help or the assistance of elderly people for an affordable fee have made it easier even for families in which both parents go out to work to have children.

Family planning these days focuses on a far later period of life. Young adults first want to consolidate their careers and climb at least the first few rungs of the ladder before they think about starting a family. Although the number of children is on the rise again, this is not because individual couples are having more children. Instead, people who frequently change partners often want to

Scenario 1 – Life in the year 2020 – The family

have one or more children with their latest partner. This has created a situation where a considerable age gap often separates half-siblings. The children from the first partnership therefore often assume more or less a parental role toward their new brothers and sisters. Adoption is now also more popular. In many families, the children's social and genetic parentage is not identical – not least due to frequent changes of partner.

The dream of the made-to-measure baby, i.e. the conception of healthy children with exactly the desired features and attributes, remains just that: a dream. In Europe, embryo selection prior to pregnancy and interventions affecting embryos and fetuses during pregnancy are both subject to stringent restrictions. Instead, more and more use is being made of advancing technologies (such as cyber-assisted aids to vision and hearing) to help the blind and deaf overcome congenital defects.

Both society and the family attach great importance to children. A lot is expected of them, and great expectations are placed in their development. It is hoped that early education and a pronounced performance orientation will afford children happy and successful lives. As a result, many children suffer from their parents' excessive "care." "Track your kid" accessories such as ankle bracelets that let parents know the exact location of their child at any time are nothing unusual.

Children also have to cope with the variegated assortment of "important others" they encounter in today's narrower and wider family contexts. From their earliest days, they therefore no longer fix their attention on just one or two key adults. This fact goes some way to offsetting parents' excessive caution and helps the children themselves to become more independent. Lack of commitment is, however, causing social relationships to suffer.

Many such families employ household help who often live with the families for whom they work, as they did a century ago, and who are often paid a very low wage. Recruiting such assistance has become easier since governments agreed to subsidize household help who look after children as an alternative to day

nurseries. The “division of labor” in the home has also become far less gender-specific. Many fathers now play a more active role in bringing up their children, for example.

2.2.3.2 Young people

The media is a constant companion from earliest childhood. As a result, most people develop a conscious strategy to deal with the media. They also absorb and assimilate information more quickly than in the past, although some young people exhibit a decidedly unhealthy dependence on the media. Communication technologies enable people to arrange to meet friends and acquaintances spontaneously. Youngsters can also choose quickly and easily from a broad selection of leisure activities. During their formative years, many people also devote a lot of time to playing computer games and living in “cyberspace.” For most young people, this is simply an additional experiential dimension in which to live and play. Some, however, immerse themselves in cyberspace to escape from the real world. Faced with the exacting challenges of everyday life and inundated with a constant flood of external stimulus and information, these youngsters feel hopelessly out of their depth in the routine of life. With so many options available to them, the path from youth to adulthood is no longer as clearly marked out as it used to be. True, clear lines used to be perceived as restrictive. But at least they gave a sense of orientation. Now, some feel isolated and lonely – sensations that are often accompanied by the consumption of drugs and alcohol.

Breaking free from the parental home is considerably more difficult today than it was 30 years ago. Society is awash with values and lifestyles that are no longer clearly assigned to specific generations. Youngsters therefore have little chance to set themselves apart from the values and behavioral norms of their parents. Another issue is that, as the “important others” in family contexts now change more frequently, young people often find themselves sucked into their parents’ conflicts with partners. Willingly or otherwise, they even shoulder a measure of responsibility in the precarious relationships that their parents try to build. Committing to initial partnerships at an early age and belonging to small “elitist”

groups with extravagant interests are perceived as ways to “cut the umbilical cord,” shape one’s own life and attain recognition among one’s peers.

Even in a society in which older people predominate in purely numeric terms, youthfulness remains a prized ideal. Young people are targeted as consumers and employable individuals. The business community values the fact that they are open to new things and eager to consume. Companies offer youngsters attractive development opportunities. Those who work hard and well find all kinds of career doors opening to them.

2.2.4 Home life

2.2.4.1 Home life as the core focus of life

Over the past 20 years, people have come to make far more intensive use of the homes in which they live. “Homing” is indeed the name given to a new trend that has two distinct root causes. One is that the home provides a place of refuge from the grueling demands of life as a multi-jobber or double-income family. In line with this perception, many of the sports and recreational activities that used to be pursued outdoors are now being “internalized” to maximize the time spent together at home. Sales of home saunas, indoor fitness equipment and family games have therefore risen sharply. The other root cause is that the number of one-person businesses whose “company headquarters” are a desk in the spare room at home has likewise increased. The same is true of the number of employees who spend more time working from home now that a more flexible labor market demands less office presence.

2.2.4.2 Smart homes

The networked, automated and remote-controlled home (a subset of what is known as “domotics”) has been one of the main fields of innovation in the past decade. Technology has been introduced that allows door locks and alarm systems, room temperature, lighting and communication facilities to be controlled

from a single console. It is even possible to communicate with the individual items of equipment via data lines. Networked ovens and washing machines, for instance, can be activated from the office. Conversely, these appliances notify their owners (by mobile phone, for example) in the event of a failure. Heating, lighting, hot water and air-conditioning systems can also be remotely controlled, allowing energy to be used more sparingly than in the past. Self-learning computers identify the family's habits and routines and remind them to turn off the cooker, say. The alarm clock is hooked up to the navigation system, so it independently determines when it will go off within a preset window of time depending on the traffic situation on a given morning. Since household appliances are networked to each other, the news that the cake is ready can now be flashed up on screen while a program is showing on TV.

Two factors have contributed significantly to acceptance of the networked home: instruction manuals that were as wordy as they were incomprehensible (and that for each and every appliance); and the swollen ranks of remote control units that cluttered many a coffee table, triggering a condition referred to as “technostress.” By developing integrated solutions, electronics firms have been able to strike the right balance between excellent technology and maximum convenience. Add-on voice control consoles are available for those who still regard touch screen operation as too much like hard work. And, thanks to mass production, these solutions are now on the market at affordable prices.

Monitors are mounted in different rooms to let people continue watching TV while on the way to the refrigerator or keep an eye on sleeping children.

The term “living room” is showing its age and is gradually being replaced by the notion of a “media zone.” This zone accommodates the home's central computer, which delivers a movie theater-standard TV experience, a live concert-standard sound experience, and functions to tailor TV programs to individual preferences. Some of these computers are even integrated in “interactable” interfaces, which let people work, surf or play electronic games with other family members from a single table that usually occupies a central position.

Scenario 1 – Life in the year 2020 – Home life

With both parents holding down one or in some cases more jobs and the children out at school all day, family members now spend less and less time together. “Home marketplaces” are one direct consequence of this trend. Affectionately known as “fridge screens,” these marketplaces are usually built into the refrigerator door or whatever place is most often frequented by family members. People can leave messages for each other on the touch screen, watch or listen to the day’s TV or radio news while cooking the dinner, check whether the refrigerator needs to be replenished, compile an electronic shopping list, or download recipes off the Internet.

At the same time, more and more families are creating a technology-free zone that lets them take a time-out from an increasingly technologized world, a haven of complete freedom from disturbance and outside influences. Often, this room is the bedroom or a hobby room, a place where people can pursue quieter, more sedate activities such as meditating or painting.

2.2.4.3 City life

Towns and cities combine an advanced infrastructure with a broad array of leisure and entertainment facilities. In 2020, they are mostly inhabited by two age groups. One is young people, whose marked propensity to consume makes close proximity to bars, cinemas and shops a decisive factor. In addition, smart bed-sits and two-room apartments are now available to single people and young couples, as are larger, low-cost apartments in less attractive residential complexes due to the conversion and combination of multiple smaller apartments. Average living space per capita has thus increased noticeably since the turn of the millennium. Older people too are rediscovering the attractions of urban life, and more and more of them are moving back to the city. Service-oriented alternatives that feature shopping, cleaning, entertainment and an assortment of caretaker-style services appeal to this age group. Many plain and formerly vacant residential blocks built between the 1950s and the 1970s have now been converted for this purpose. Since rents are also subsidized, service-oriented homes have become a viable option for many older people.

Families and middle-aged people also live in attractive cities that exert a magnetic pull on tourists. By contrast, less attractive cities, former industrial conurbations and towns in regions that are no longer attractive to businesses often have a lot of housing standing empty. Seeing no evidence of an urban planning policy that prioritizes nature and open spaces, former residents flee to the outskirts of such agglomerations. This trend will remain unbroken until such time as local governments resolve to bring nature back into their inner centers through a program of conversion and revitalization.

2.2.4.4 The new “cities outside cities”

The popular flight to *zwischenstädte*¹ – new towns and cities on the outskirts of major conurbations – has long been a recognized phenomenon and has continued unabated over the past two decades. Families in particular, but also some middle-aged single people, see this solution as an ever more acceptable compromise between good infrastructural facilities, affordable living space and close proximity to nature. In the USA, the “new urbanism” wave sparked the attractive redesign of many of these *zwischenstädte* – and inspired European urban developers in the process. To a great extent, these new developments have assumed the function of historic city centers, grouping shops and entertainment facilities together in symbolic hubs. Factory outlet centers, multiplex cinemas, aquatic parks, (musical) theaters and discotheques consciously superimposed on a former factory hall setting have cultivated a new taste for suburban tourism.

Heavier expenditure on health care and pension contributions, irregular income patterns for many people as a result of more flexible labor markets, and cutbacks in public assistance have all driven stronger demand for low-cost owner-occupied housing with optimized running costs. The building industry responded swiftly by stepping up prefabrication and including both shell constructions and low-energy homes in their standard portfolios. This trend toward “cheap and cheerful” homes has given rise to large estates of virtually identical terraced housing in the *zwischenstädte*. Most of these dwellings include basic networking and digital information and communication fittings.

¹ “Zwischenstädte”, the German term for this phenomenon coined by Sieverts, translates roughly as “cities outside cities” or, in Sieverts’ own words, “cities without citizies”. This article follows common usage among professional commentators, in which *zwischenstadt* has now entered the English language.

Suburban locations that are situated in economically weak regions and have large volumes of unattractive, standard-issue housing from the last century are today suffering from high vacancy rates. Manifestly the worse for wear, these buildings are inhabited by the very lowest income groups and low-wage-earning immigrants. As a result, they are increasingly turning into explosive social flashpoints. In Eastern Europe, new *zwischenstädte* have accompanied the erection of major new industrial complexes, allowing people to live close to where they work and surrounding them with generous open spaces and attractive entertainment facilities. In the medium-term, however, these new developments are threatened by the same fate suffered by Western Europe's suburbs last century. Urban planning alone cannot make up for a fundamental lack of infrastructure.

2.2.4.5 The new face of rural life

Even in the remoter regions of Europe's economic heartland, growth in the volume of housing development is expected to continue. The desire to "get back to nature" is the primary motivation only in the rarest cases, however. And even when this is the case, it applies only in attractive regions and for people on very high incomes or self-employed creative types whose occupation does not necessitate regular face-to-face contact. Second homes and vacation homes in attractive countryside are nevertheless an important factor even for the well-off.

Elsewhere, less attractive rural areas are becoming a haven for people who have a tough time coping with the demands of working life and who have no choice but to opt for the lower cost of living and housing away from major conurbations. These people also have to put up with poor traffic connections as public transport providers are increasingly withdrawing from rural areas. The living space available in these areas often only satisfies rudimentary quality standards. In many cases, it is (wrongly) assumed that the people who live here simply wanted to return to more "real" values and concentrate on family life in a rural setting. In fact, many of them live here because their career dreams did not come true.

2.2.4.6 The convergence of public and private transport

Public and private transport have continued to converge. Transit points such as train stations, airports and park-and-ride facilities have evolved into large, attractive malls. While making it easy for people to change quickly between modes of transport, the shopping and restaurant facilities they provide have also established them as a destination in their own right.

Telematic services help people optimize the way they use road capacity. In the event of traffic congestion, they suggest alternative driving routes, but also make recommendations about good places to change to rail or citybus lines, for example. The latter can be made available on extremely short notice. Travel assistants are a regular feature of today's personal organizers. They let people call small city buses, which have their own relatively congestion-free lanes in central areas, or indicate which changes are recommended at which transit points in a specific situation. Commuter trains are highly popular. As well as carrying passengers, they also serve as modern shopping and service centers. Supermarkets, hairdressing salons and other on-board services allow travelers to run their daily errands while on the way to work.

2.2.5 Work

2.2.5.1 Jobs

It is increasingly rare for people to spend 30 or 40 years working for one and the same company. As a rule, people still learn a specific trade or profession that gives them their point of entry to working life. However, it is now far more common to move both to other employers and to other activities. It is not unusual to find people who have worked in four or five different lines of business in the course of their career. Frequently, such career changes do not involve a “step up,” but are rather motivated by the desire for a job that entails more freedom and responsibility and in which people can genuinely use the skills and knowl-

edge they have acquired. The active population is now more concerned to remain employable on the labor market than to hold down a secure job. Life-long learning, assisted by employers, has thus become a strict imperative.

As we saw in the section on the slower pace of life, people today work more hours per year and for more years of their life. Yet they no longer work as intensely as in the past. In particular, this has gradually eased the excessive burdens that used to weigh heavily on high performers. Work times have become considerably more flexible. While customers ultimately determine the dates by which work must be done, companies still try to accommodate their employees' need for a sensible balance between work and private life. Job sharing and innovative work time models make this task easier. Many firms have introduced a kind of "siesta culture": Staff who want to take a longer break in the middle of the day can take two to three hours off, allowing them to fit their working time around private preferences and appointments.

Two lines of work have experienced especially strong growth: One is the whole area of personal services that involve a high volume of personal contact hours. Nursing and security services are two examples. The other is what is known as the "brain worker" (or knowledge worker) segment, i.e. activities in which people have to process and apply knowledge. These knowledge workers are driving innovation in Europe and can be found in every industry. Some of them also operate as self-employed full-service providers, coordinating the activities of other companies and adding value by contributing their own expertise. For example, a one-person prime contractor might be commissioned to handle the renovation of an entire building or building complex.

2.2.5.2 Corporate management

Over and above their necessary basic functions, today's companies are committed to three objectives:

- Sound leadership must motivate employees and create an environment into which they can channel their full energies and contribute their skills and knowledge.

- Companies are committed to sustainability on two levels: in their responsibility toward society and the environment; and by managing diversity, i.e. employing people of all ages and cultures and both sexes in the company's own best interests.
- They are committed to upholding their corporate reputation, i.e. earning and maintaining the respect of the media, investors and opinion leaders.

These days, just as many women as men can be found on every level of corporate management. The management climate, too, has changed markedly. More communication, more employee involvement in management decisions and greater social skills are management criteria that have accompanied direct demands for performance-oriented compensation and a harder, more open approach to conflicts in what is, on the whole, nevertheless a fair environment in which to resolve differences. One central aspect of the new management style is that all decisions are required to be absolutely transparent.

Alliances between large corporations, but also between small and medium-sized enterprises, play an important role. Airlines are only one example of companies that need to optimize capacity utilization. Their example is now being followed by other service providers such as mobile phone providers and logistics firms, hotels and parking facility operators, all of whom are teaming up with the same goal in mind. Numerous companies based in Europe's economic heartland are likewise joining forces with their counterparts in Eastern Europe. These alliances aim to combine the former's management lead in the areas of innovation and marketing with the more attractive labor costs afforded by Eastern Europe. Many of these alliances turn out to be the precursors of full-blown mergers.

2.2.5.3 Goods and services

Product and service offerings have evolved in line with market demands. Luxury goods are still available for the affluent. But the bulk of today's retail merchandise consists either of the standard, mass-produced goods that are sold by discounters, or of more target group-specific products for a more up-market clientele. In

Scenario 1 – Life in the year 2020 – Work

discount department stores, discount supermarkets and teleshopping channels, everything is standardized – from packaged foods to fully preconfigured computers at rock-bottom prices.

Today's customers have the opportunity to have their cars, computers, TVs and hi-fi equipment assembled to their personal specifications. Such items are built to order. A number of restaurants have followed this trend, allowing guests to put together the meals of their choice from a selection of ingredients, and to choose which services they want to use.

More and more service offerings nowadays expect the customer to shoulder a substantial portion of the financial burden or work involved. Teleconsulting on health care issues is one example. Customers who take advantage of self-storage offers or organize their own move to a new home, say, are often supplied only with space and/or the means of transport. They have to decide for themselves whether to drive the truck themselves or to leave the container handling to the service provider; whether they or the service provider should assume responsibility for items kept in storage; and so on. Countless other services can be mixed and matched along similarly flexible lines.

The change is perhaps most apparent at travel agencies. At the end of the 20th century, these agencies still predominantly brokered package tours or customized travel packages. However, attractively priced offers on the Internet led many consumers to start putting together and booking their own vacations directly. In addition, pricing models in which tour operators, car-hire firms, railway companies and airlines no longer paid commissions to travel agencies threatened the latter's very survival. Having since repositioned themselves, agencies now bundle demand to obtain "special" prices, better-quality rooms and other added extras from tour operators and hotels. This strategy has helped them build up a solid base of regular corporate and retail customers. They also levy a flat-rate service charge for handling travel management from end to end for corporate customers.

2.2.5.4 Customer relationships

Manufacturers, retailers and service providers continue to focus more and more attention on customer relationships. An understanding of how positive recommendations by happy, loyal customers boost business has inspired companies to proactively manage word of mouth. As a free service to end customers, all kinds of service providers now offer to examine the vast array of products and services on the market and filter out those that most closely match the requirements of the individual.

In 2020, manufacturers, retailers and service providers no longer manage the personal customer information they use for one-to-one marketing in a host of disparate customer databases. Instead, customers themselves now commission brokers to gather the information (and in some cases sample products) that they need. In line with customer orders, these brokers then collaborate with individual suppliers to piece together attractive marketing campaigns and offers. To this end, they are permitted to compare customer data with the supplier's databases. However, to ward off the threat of invasion of consumer privacy, the customer data remains securely in the hands of the broker. Since it is in the customers' own best interests to keep their data up to date, obsolete and/or incorrect customer data is now a rare exception. Coverage loss has thus been slashed and one-to-one marketing is far more widely accepted.

Retailers increasingly charge fees for the advice they provide to customers. Customers are, however, free to choose whether they want advice or not. Top customers collect bonus points that they can trade for advice. Since the price of actual products has now been separated from the cost of advice, specialty retailers – whose prices used to include the high cost of providing professional advice – are now in a position to price products more competitively. On product price alone, large specialty retailers who employ customer consultants can now compete with the discounters. Advice is offered free of charge only in the luxury item segment, usually at the expense of the manufacturer.

In the retail industry, e-commerce plays a pivotal role, especially in the sale of daily essentials and convenience goods. Retail groups operate e-commerce channels and bricks-and-mortar stores as two separate lines of business. Purchasing terms are optimized and logistics experience is leveraged to get goods shipped at low cost from the producer to the consumer. Consumers can then save money by picking up the goods they have ordered using e-commerce from the local store. Conversely, goods bought at a regular retail store can also be delivered to the customer's door in return for a fee. Bonus programs for customers integrate both channels, rewarding consumers equally for in-store and e-commerce purchases. This development has sharply improved customer loyalty even in the context of e-commerce. Customers are now far less likely to switch between different e-commerce providers.

2.2.6 Consumer behavior

2.2.6.1 Conscious consumption

For the majority of consumers, the fanfare that has so often surrounded consumption in recent decades has run its course. People now know the price of a consumer-oriented lifestyle. They have come to regard a healthy balance between work and private life and values such as social responsibility and fairness as more important than the transient, insubstantial “values” of fashion-consciousness, beauty and youthfulness. By consequence, consumers are now far more interested in what a product really delivers than what the advertising promises – or in the “kick” derived from the experience of buying. Society has shifted toward the view that “less is more.” For instance, people no longer rush out to buy the very latest computer or electronic gadget. They are perfectly happy to skip a product generation or two. Ethical considerations are another important issue that make people “feel good” when they consume: They want to know about aspects such as gray energy and working conditions in low-wage countries.

2.2.6.2 Price-aware consumption

Having been deeply disillusioned by the empty hype of rampant consumerism, but also due to the decline in disposable income, people now pay more attention than ever to the cost/benefit ratios of the products and services they purchase. Test magazines that evaluate both aspects are enjoying a boom, as are consumer exchange marts. People do not want goods that are “cheap at all costs,” however. They simply want value for money. Products that are worth the money people pay for them are therefore on offer in discount and premium stores alike. Accordingly, people buy a mix of discount merchandise and branded products that give good value for money. They often buy the latter at knock-down prices from factory outlets, over the Internet or at “virtual flea markets,” however.

There has been a powerful resurgence in products and services that require a measure of customer input. Apart from the benefit of more attractive prices, people enjoy the experience of “doing their bit” and can identify more strongly with the finished product. DIY stores, furniture stores where people transport and assemble their own furniture, and retailers who sell semifinished products (such as dough that only needs to be baked or furniture that has to be oiled or varnished) are therefore all doing a brisk business.

The general reduction in disposable income has nourished a resourceful streak in many people who are keen to maintain their standard of living. All kinds of real and virtual service networks have thus sprung up, including many offered by providers operating in the black economy.

2.2.6.3 Gray consumers – a new target group

No-one wants to be perceived as old and unattractive. On the other hand, past advertising images that often portrayed young people made up to look old did not ring true. Nowadays, people feel that the portrayal of older people in advertising fits in with their own self-image (which is mostly 10 to 15 years younger than the reality). Given the attractive selection of ideal models available in the middle age bracket, such portrayals are accepted as credible. All the same, peo-

Scenario 1 – Life in the year 2020 – Consumer behavior

ple prefer not to be addressed explicitly as “senior citizens.” The more subtle “best ager” epithet instead seeks to emphasize the vitality and active lifestyle that this age group still enjoys. Even magazines that used to target the forty-something age group clearly show that older people do not want to be reminded of the painful transition from middle age to maturity by constantly being confronted with their own physical age. Products designed for older people sell well. Examples include cars that are easier to get into, windscreens with optically enhanced glass, and foods that contain supplements to make up for the deficiencies of old age. However, vendors must be careful to avoid advertising that focuses on old age. Intergenerational advertising is the order of the day, in place of a selective focus.

As people grow older, their personal interests, habits and ideas take on increasingly sharper contours. Over fifty-fives are therefore no longer regarded as a homogeneous market but are split into different categories. Today’s senior citizens want to be addressed on the basis of their interests, not their age. One possible breakdown of the “generation plus” is to distinguish between bon vivants who like to enjoy the best in life; adventurers who are very mobile and open to new experiences; home-workers who have a pronounced “safety-first” mentality and spend a lot of time working on their house and in the garden; and connoisseurs, who set great store by knowledge and culture. These different groups share a common predilection for deeper values that are heralding their gradual withdrawal from a superficial consumer society. Convinced that “buying on the cheap” can end up costing twice as much, they, too, attach far more importance to value for money when they buy.

An early experiment in supermarkets targeted specifically at senior citizens never really got off the ground. Many retailers have, however, since adopted the point of sale designs that these stores tested. Shelves are thus stocked with smaller food portions. The LCDs that indicate the prices and names of products use larger type. And shelves featuring conveyor technology make it easier for, say, people in wheelchairs to reach the products they want. Competent, older sales staff, shopping carts that double up as walking frames and a certain number of wider parking spaces are now taken for granted in most places.

Stores no longer label these facilities separately. As a matter of course, manufacturers, retailers and e-commerce stores test their websites to see whether they are “old people-friendly.”

2.2.6.4 Back to reality

Now that there is less disposable income to go round, the consumer experience has lost its shine and the brand cult has been demythologized, people prefer to buy no-name or own-brand products for their daily needs. The real value afforded by a product now takes precedence. Accordingly, people’s experience of real value causes them to develop a loyalty toward products rather than brands. Consumers feel they are back in control. Whenever they choose, they can use e-tags to verify the alleged quality of food products, the promised delivery route and the guaranteed delivery time. As a result, products are mutating into services that place self-determination back in the hands of the consumer. A new brand purism has taken the place of brand and product diversification. People now spend money where experience shows that it is worthwhile doing so. At the same time, there is a palpable yearning for the genuine, the authentic. People therefore gravitate strongly toward products that bear the sender’s details and clearly indicate where they were made or assembled. This focus on authenticity is driving a renaissance in small-series production forms (such as furniture, food-stuffs and textiles) that set a welcome counterpoint to mass-produced goods. This is one more area in which new brands are emerging. Another trend is toward an increasingly “dematerialized” lifestyle in which people would rather use things than buy them. Various forms of rental and leasing are becoming more and more important in this context. Thanks to community-spirited neighborhoods and the ease with which regional communities can take shape on the Internet, the sharing and pooling of more expensive home equipment is now a more common occurrence, adding a social and sustainability component to modern consumption.

Consumer goods are largely distributed by parallel “high tech and high touch” systems. The convenience of teleshopping and Internet shopping is used to complement stationary retail: Price-aware customers go shopping at relevant

Internet portals, visit e-outlet stores to buy branded items, and also use TV shopping services. These distribution channels are convenient and let people buy whenever it best suits them. Even so, they will never completely take the place of bricks-and-mortar stores simply because of people's preference for human contact and the ability to see and feel what they buy. That is why teleshopping supplements rather than substitutes for other channels. And that is why even people who use electronic communication media still also go the local store. In response to a widespread preference for natural products, farm produce markets, weekly markets and organic food stores are now regarded as mainstream. Produce is displayed "authentically" in crates and baskets, with no trimmings. The close link between sellers and what they are selling fosters even greater trust in the authenticity of these products. Probably to counter the trend toward discount and chain stores, a culture of kiosks and microstores has also sprung up. These outlets have long opening hours and offer a broad selection of goods. To some extent, they also constitute points of contact in a society that attaches great importance to social interaction.

2.2.7 Travel

2.2.7.1 Less long-distance travel

In recent years, vacationers have become disillusioned with overseas destinations. Artificial tourist set-ups have been exposed as a sham, a poor attempt at a "paradise ersatz." Increasingly, this painted pretense of perfection has left people who went off looking for a happy, contented holiday feeling cheated and disappointed. Heavier expenditure on health care and education has also squeezed travel budgets, with the result that short breaks are now becoming more and more popular. This being the case, the radius within which people travel on vacation has shrunk considerably. Many more people now vacation within Europe or in their home country.

2.2.7.2 Vacation in one's home country

Numerous variations on the theme of vacation in one's home country have emerged. A resurgent romantic view of nature, which is felt to be "pure," has caused private guesthouses and vacations in the countryside to flourish. Adventure tours are another alternative. These tours project the image of wild, unspoiled nature onto natural surroundings and offer intensive experiences as a counterweight to the shallow routine of everyday life. Keen to foster and service these deeply-felt yearnings, local providers have long since begun to guide tourists up mountains, shoot rapids with them, traverse glaciers and trek through national parks. The idea of having to travel to foreign countries to engage in such pursuits has become all but superfluous.

A different angle on the same concept is the practice of mapping the illusion of distant, exotic locations onto native shores. Families can, for example, spend a few days' vacation under a glass roof in an artificial paradise complete with South Sea palm trees and sandy beaches. Yet another option is the "journey back in time," where people immerse themselves for a few days in the Middle Ages or the Baroque era, wearing period costumes and taking part in mock-ups of everyday life at that time. These experiences are lived out in a series of new historic parks. The latter two variants may be every bit as stage-managed as the far-off locations themselves used to be. However, they cost less overall, are easier to reach, and do not depend on the weather conditions. Accordingly, many people have come to prefer this kind of short-stay vacation, despite the steep price of entry tickets. There is one more important difference: The longer one stays at these home locations, the more the (consciously chosen) illusion becomes reality. By contrast, the illusion that exotic resorts try to dress up as reality becomes ever less convincing as time goes on.

2.2.7.3 Vacation at home

Low travel and vacation budgets are also the reason why people now more often spend their vacations at home. Local parks and recreational areas where people can go swimming, play beach volleyball and have barbecues are heavily

frequented. Other favorite venues for vacations at home are wellness centers. Set in attractive, purist, Zen-style buildings or revitalized health resorts and spa grounds, these centers provide “soft sports” programs, aquatic therapy, massages, beauty treatment and meditation rooms under a single roof. These facilities aim to meet people’s need to relax and be pampered as welcome relief from the rigors of working life.

2.2.7.4 More self-determination in the choice of vacations

In the past, the predominance of package tours catered to popular demand for convenience. This focus is, however, being replaced by more customization and greater self-determination. Travel firms have recognized this trend and begun to offer modular strategies that let customers mix and match the individual components of their vacation (hotels, flights, car rental, travel itineraries, etc.). With or without the assistance of professional consultants, consumers thus become the producers of their own travel itineraries. Slipping into this new role as “prosumers” lets them regain considerable autonomy. More and more would-be travelers no longer even bother to go to the local travel agency, however. Travel portals that let customers walk through hotels online and read what other vacationers say about a given hotel or destination create a more trustworthy impression than the carefully cropped views presented in two-dimensional glossy brochures, or than the advice provided by in-store travel agents. Internet-based providers are also catering to growing demand for spontaneous travel and low-cost specials.

2.2.7.5 Stage-managed authenticity

The travel industry has undergone radical change. It increasingly aims to respond to people’s longing for authentic experiences. Many travel offers center around care for and development of the individual, for which the new “Club Meds” (“med” now referring to “meditation”) provide the ideal setting. Health care consultants, therapists, coaches and artists present a rich diversity of courses and workshops to help people find themselves in an atmosphere reminiscent of the traditional holiday club.

Authentic vacation experiences are also sold in a completely different context. Far removed from everyday life, in isolated and often remote regions, vacationers are accommodated in tents or rudimentary huts, experience close contact with the indigenous population, and travel mostly either on foot or using customary local means of transport. Stage-managed, back-to-the-roots authenticity is thus opening up a new market for travel operators.

Today's European populations are older, better educated and well traveled. For many, therefore, a genuine sense of adventure can only be derived from in-depth encounters with alien cultures. Such vacations thus become exercises in personal study and development. Accordingly, this form of travel has evolved into a stable market segment.

2.2.7.6 Discovering Europe

The expansion of the EU, easier travel conditions and lower prices have enabled a number of Eastern European countries to carve out a niche as popular tourist venues. New cities, new landscapes and the remote, unspoiled splendor of steppes and mountainous regions have replaced the jaded icons of famous places that everyone knows. Now, far more unfamiliar destinations are at last rekindling a long-forgotten taste for adventure. Travel is taking place in both directions, however. Many of the standard-issue hotels that once stood empty on the shores of Southern Europe are now visited predominantly by Eastern European tourists who still have some catching-up to do and who can afford the low prices charged for what is now mostly ageing accommodation. China too has continued to open up. As travel activity has increased, Europe has established itself as the number one destination for tourists from the Middle Kingdom.

2.2.7.7 City tours – a brief escape from the routine

City tours have become far more popular on the back of a higher general level of education and a growing interest in Europe's shared cultural heritage. Single people and childless couples are the primary target group for these tours, as they have more money to spend and can be more flexible about the timing and content of their trips. Hotels now consciously cater to city travelers as a target

group that itself breaks down into several subgroups, each with its own distinctive style. Hotels that provide a spiritual/meditative ambience, an environment-friendly/natural setting or a youthful/trendy flair can be found almost everywhere. Individuals can thus choose the hotel setting that best suits their lifestyle, transforming these establishments into a very real “home from home.”

2.2.8 Leisure

2.2.8.1 Focus on relaxation

Popular awareness of the need for a healthy balance between work and home life leads people to spend much of their free time relaxing and recharging their batteries. In cities and *zwischenstädte*, a bountiful selection of Zen gardens, mazes, nature trails and the like, enhanced by appropriate sound systems, gives people room to meditate, to breathe. The ability to consciously relax is increasingly developing into a “core competence.” Meditation and quiet rooms at wellness centers and the quiet rooms that many people have at home create an ideal setting in which to learn and progress in this discipline. Wellness and all the variations on this theme – from aquatic therapy to yoga – are a boom industry. Personality seminars and contemplative weeks also help people to relax and get more in touch with themselves.

2.2.8.2 The principle of slowness

On weekends, a lot of time is set aside for “slow” activities such as simply being together with one’s family or partner, cooking, or working in the garden together. Family time is regarded as quality time, so people make plenty of time to talk, play games together or take short trips out into the surrounding area. The pace of life slows down as people restrict themselves to a small number of activities which they then enjoy more intensively. Service providers now filter data from print media and detailed news broadcasts in line with individual interests. They personalize the condensed data they supply in an attempt to stem the rising tide of daily information. But people also use part of their free time

to be completely alone. This time is spent reading (printed material or over the Internet), consciously listening to music, or engaging creative pursuits such as painting, crafts, pottery and writing. The “fun and party” wave has ebbed, giving way to a new, more contemplative mindset.

2.2.8.3 Soft sports

Since sport now serves primarily to enhance the individual’s well-being, there is no compulsion to achieve. Gentle jogging, Nordic walking and rambling have thus become commonplace activities, sometimes as a communal experience in the company of established wellness groups. In the sporting arena, the spirit of competition expresses itself more in terms of mental agility than physical strength. Golf and archery have therefore evolved into mass sports.

2.2.8.4 Sports tailored to specific age groups

Young people still want to test the limits of their physical capabilities, however, and therefore devote some of their leisure time to soccer, jogging, snowboarding and cycling. Around the turn of the millennium, sports clubs saw the number of younger members dwindle alarmingly. As a result, they now concentrate far more on trend sports and outdoor pursuits. They have also transformed the former “school gym” atmosphere into a much more appealing environment, set off by extras such as free-climbing walls and half-pipe installations. They also organize small-scale events to nurture a sense of togetherness. For the first time in a long time, membership is back on the rise among younger age groups. Wellness centers that have grown out of what used to be fitness centers are highly popular. People up to the age of 30 or so are the ones who usually take advantage of fitness equipment and programs, while older people gravitate more toward the soft sports and pools provided in the wellness zones. Membership of these centers is an obsolete model. They have only been able to fight off competition from sports clubs, thermal baths and a stronger focus on outdoor pursuits by freeing users from contractual constraints and providing attractive offers for specific age groups, such as over-50s and over-60s.

2.2.8.5 Games and relaxation

The tendency for people to spend more leisure time with family and friends has also brought games people can play together back into fashion. Alongside old-fashioned card games and classic board games, many people now also enjoy role plays that merely set a general theme (such as “cyberpunk,” “fantasy” or “modernism”). These games are played out online or physically: A professional moderator supplies the players with a trickle of information and assistance as they together seek to solve a problem or complete an assignment.

2.2.8.6 An understanding of European culture

Cross-border cultural projects such as the designation of a different cultural capital each year, touring art exhibitions, and pan-European media coverage of cultural themes have fostered an awareness of the continent’s common cultural heritage. This development has been further encouraged by the rise in city tourism within Europe. People are especially keen to get to know the cultures of less well-known countries in Eastern Europe. Equal attention is given to architecture, art and the theater.

2.2.8.7 A new theater culture

Shrinking public budgets for culture and the arts have eroded prestigious cultural venues and events in small and medium-sized towns, where most theaters have been closed down. By contrast, the large and impressive playhouses designed to lure tourists and generally well-off audiences still receive government subsidies. Traditional literature is the staple diet. Room for more creative and experimental performances is limited. One counter-trend has thus been the emergence of a new theater culture that appeals to the majority of theater-goers. Small, unaffiliated theaters experiment with active and interactive forms of their art, including lay performances, improvised theater and thematic theater. This new culture marks a return to something closer to the original idea of the popular stage as a place of social encounter.

2.2.9 Media and communication

2.2.9.1 Electronic media and communication platforms

European countries have become very open to new technologies. This fact, coupled with state subsidies, has prevented a digital divide from splitting Europe. Not all new developments have become firmly established, however. Some are simply too expensive. Others are not feasible owing to the lack of infrastructure in some countries. Communication standards have been harmonized throughout Europe and networks are ubiquitous. The use of mobile phones for multiple purposes (as credit card substitutes, for example) has become popular. And UMTS services allow users to look up bus timetables and movie programs, and to perform various routine tasks.

Large numbers of hotspots have been installed in major conurbations, enabling people to work from cafés and parks, for instance. Wireless LANs (WLANs) have finally allowed wired and mobile systems to converge. New technologies make it easier to exchange data immediately and contact other people at any time. Random dating on the street, for example, has become a popular pastime.

Television too is now more closely adapted to people's requirements. Interactive TV has proved highly entertaining; and viewers are no longer bound to set times for specific programs. The PC provides the main platform for electronic communication and the use of various media – it is the beating heart of every household "media zone." Mobile equipment plays a key role in everyday life. Since low-energy mobile phones can now be used to transfer large volumes of data, people are no longer tied to their desks. The private sphere and public space have effectively blended into one, with the result that people have fewer inhibitions about discussing private affairs in public.

Sensory overstimulation in urban areas has assumed frightening dimensions. Interactive outdoor advertising floods people's mobile phones with (unsolicited) communication and bombards them with advertising messages. Built-in filter systems manage to stem some of the tide, but are unable to block all promotion

and incentive programs (such as chain marketing). Anti-spamming software successfully combats Internet advertising and Internet spam, as the spamming wave at the start of the millennium triggered the development of highly effective tools to this end.

The Internet is seen as humanity's "collective memory." It serves as a medium of self-determination and self-presentation. Almost everyone has a personal website, many of which take the form of i-blogs that their owners use to underscore their individuality and communicate with the outside world. Further progress has been made in personalizing electronic media. "My Daily Newspaper" gives people news that is tailored to their personal preferences and requirements. Personalized traffic bulletins are broadcast. And "My Radio" churns out the individual's favorite music. All these services are paid for by one-to-one marketing containing personalized advertising.

2.2.9.2 Use of the media, newspapers and magazines

Consolidation has persisted in Europe's media landscape, which is now dominated by only a handful of large corporations and complemented by a wide range of regional media firms. The number of special-interest magazines catering to everything from niche sports to unusual hobbies has also increased significantly.

Infotainment and interest in the yellow press have likewise risen sharply in recent years, for two main reasons: One is that people use tabloids and similar publications as a way to take their mind off work and their daily routine. The other is that relentless overstimulation has impaired many people's concentration. As a result, they now have difficulty reading long, complex texts. Multi-national media empires roll out a broad spectrum of tabloid magazines and websites, some of which feature pan-European news. That is important because, nowadays, people in Latvia are interested in exactly the same celebrity news as, say, people in France.

Newspapers and the Internet have become more tightly interwoven. Newspapers' websites seek to complement the printed edition by providing film clips, background information, discussion forums and the like. The two media are, however, so deeply interlinked that readers use both in practice. Free access to online media is only available to a limited extent. Online advertising revenues have been in constant decline for some years – unlike revenues from text message and MMS advertising, which are still growing. In response, website owners have introduced online charges to enable themselves to maintain certain quality standards. That is also why fees are paid for online-only newspapers, for example.

2.2.9.3 Books

User-friendly tools with large, high-resolution screens have fueled growth in the market for electronic books. Books on demand are likewise extremely popular as they can be adapted to individual requirements and printed at low cost.

Despite these advances in e-book technology, the Internet has still not killed off the printed book. Books remain the literary world's staple diet; and books with minimum print runs have successfully defended their market position. Indeed, the number of books published and sold is growing constantly, although it is questionable how many of them people actually read. There is a wide range of websites and communities that write and disseminate literary texts and support unknown authors. But they, too, have been unable to edge out books in their conventional form. The Internet has, however, given young authors whose manuscripts are rejected by publishers an online forum in which to post their works and thus find their own audience. Books still rank as attractive presents, classic examples being large-format art volumes, special gift editions and first-run publications. The desire to own a physical library remains unbroken, especially for those who prefer to spend their free time at home. Since books are such handy traveling companions, electronic books have complemented but not replaced them.

2.2.9.4 The Internet

In the year 2020, virtually everyone in Europe has access to the Internet, which has thus fulfilled its original aim of creating equal opportunities and being available to all. Everybody now has the chance to add to their knowledge or share it with others. This has in turn helped people become more flexible and more open. To a large extent, the Internet now shapes the way people live and work. Having initially been used mostly for research and information purposes, it has now become an everyday medium and a platform for communication.

The kind of “emotional striptease” familiar from any number of TV shows and documentaries, in which people bare their soul to the anonymous masses in extremely personal interviews, has now made its way onto the Internet too. People use Internet forums to search for meaning, exchange views with like-minded people and find soul-mates. Virtual communities are one example of how communication has expanded in this direction. One of the key perceived benefits is that anonymity allows people to talk more freely about very personal issues. At the same time, communities substitute for real relationships. For “gray surfers” in particular, this medium presents a welcome way to stay in touch with other people in spite of physical limitations. This social aspect of communities keeps many from becoming isolated.

The theory expounded by American Internet pioneer Howard Rheingold, who coined the term “virtual community” and, at the start of the 21st century, defined “smart mobs,” is now present reality. In Rheingold’s view, the joint activities of interest groups, mobile communication and always-on Internet connectivity mutually reinforce each other in such a way that “virtual” communities begin to spill over into real life. Electronic communication tools such as mobile phones, the Internet and PCs allow groups to coordinate and organize themselves quickly and easily. Smart mobs can be found everywhere: The spectrum ranges from organized car-sharing through political demonstrations to “mobs” that club together to take advantage of bulk discounts. In isolated cases, smart mobs that organize political protest campaigns have even precipitated the downfall of elected politicians.

2.2.9.5 The quality of communication

Growth rates in the communication industry are higher overall, with mobile communications leading the field. Passive TV consumption has been replaced by passive Internet consumption. On average, people spend more than four hours a day on the Internet.

Electronic communication has had an adverse impact on language and the ability to formulate speech. This is partly because some people now only ever read excerpts from books. And even these excerpts are only scanned, in the same way as people speed-read newspapers. A further factor is the habit of communicating via multiple channels simultaneously, i.e. making phone calls while reading and even writing e-mails. This practice has made the language used ever more basic. Time is another reason why communication is kept short and to the point. At the same time, new ways of communicating supplementary information are constantly emerging – in the same vein as the abbreviations and keycodes that were widely used as e-mail jargon early in the century. Commonly understood codes thus still allow people to express emotions despite the condensed structure of most modern communication. Instances of addiction to electronic communication are becoming more and more widespread, above all among children and young people. Also, communication must quickly gain the attention of one's interlocutor, who is likely to be absorbing other information at the same time.

2.2.9.6 Defensive attitudes

In seeking to defend their privacy and keep at least part of their lives peaceful and quiet, some people have consciously distanced themselves from always-on availability. This is due in part to the consequences of such permanent availability, one example being "information fatigue syndrome." This symptom is now looked on as a new disease of civilization. It is a burden primarily to those people who are constantly flooded with information both at home and in the office. Many then simply lose track and suffer from stress and lack of concentration. Information overload has a different effect on children, however: Many

of them develop more acute perceptive capabilities as they learn to assimilate information far faster than their forebears. On the downside, excessive Internet consumption leaves some children and youngsters isolated, passive and, above all, overweight.

Nor has the debate surrounding “electrosmog” subsided. Some people remain wary of mobile communications in general because their fears and concerns about the side-effects of this technology have never been placated.

2.2.10 Health care

2.2.10.1 A holistic view of health

Whereas people used to associate good health with the absence of disease, the last 20 years have witnessed a trend toward a more holistic understanding of the subject.

This broader concept of health and health care is reflected in the interdisciplinary collaboration today pursued by many doctors and psychotherapists at what are known as “integrated health care centers.” By and large, these centers have taken the place of individual general practitioners and shared practices. Like hospitals, these facilities offer 24/7 medical care. Equal weighting is now given to psychological and social factors as well as purely physiological considerations in both the diagnosis and treatment of disease.

Patients themselves therefore now see good health as a consequence of a healthy lifestyle. Acting on this realization, people regularly take part in “wellness groups” or sign up for “life schools” to learn how to stay healthy or refresh knowledge they have already acquired. National group networks supply copious information to help people become or stay healthy. They also publish the addresses of the doctors, therapists and hospitals that work closely with them by providing lectures, hotlines and information lines. In some cases, such re-

sources save patients the expense of a visit to the doctor. More attention is now given to the results that treatment achieves than to discussing the methods used. Accordingly, alternative medicine has become established to the extent that, in some areas (such as acupuncture), the distinction between traditional and alternative medicines is now obsolete.

2.2.10.2 Prevention is better than cure

The public health sector seeks to cultivate health awareness from a very early age. In personality development classes, children learn about the links between an unhealthy lifestyle and illness. As a matter of course, health insurers now offer bonus programs to people who take part in wellness groups or attend health care courses. For higher-risk professional groups (such as truck drivers, builders and top managers), attendance of “prevention programs” for the relevant diseases has become an integral component of professional development.

Prophylactic advice used to center around physical fitness. Today, the focus is on wellness – the ability to consciously relax and unwind. Wellness “sports” (such as yoga, Tai Chi and Chi Gong) generate keen interest and are now even taught in schools. Most people seriously apply themselves to learning these arts or techniques so that they can then practice them at home. Society in general looks down on smoking, obesity and stressful lifestyles that leave no room for relaxation. These practices are regarded as evidence of a lack of solidarity, an expression of inadequate self-discipline. Such attitudes have, however, provoked a counter-trend among people who demonstratively rebel against the tyranny of the healthy lifestyle. Bars exclusively for smokers are beginning to gain a foothold, as are “all you can eat” fast-food restaurants.

Following the lead given by the public health sector, doctors and hospitals, too, have shifted their emphasis onto preventive rather than curative medicine. Genetic diagnosis techniques have encouraged the trend and are now a regular feature of the initial examination of every new-born baby. This practice reveals any genetic predisposition to certain illnesses so that it can now be taken into account in the infant’s future lifestyle. Non-genetic illnesses and vitamin defi-

ciencies, for example, can be detected by biosensors at a much earlier stage and remedied in good time. Tiny “diatherapy” chips (chips that serve both diagnostic and therapeutic purposes) can supply the body with the necessary medication as soon as a diagnosis has been made. Prenatal diagnostics have been improved and can be used from very early developmental stages, reducing the risk to mother and child during pregnancy.

2.2.10.3 Health insurers

Health insurance is now a statutory obligation across much of Europe. The health insurers and national funds that back this program nevertheless only provide basic health care coverage for a defined canon of treatments. Everything that goes beyond these methods must either be covered by supplementary insurance or paid for by the patient. Far-reaching structural changes have transformed health insurers and state welfare systems from “payers” to active “economic players.” The MediExpertSystem now used by all doctors and therapists displays all treatments that are possible (i.e. that are covered by the program) in a given case and lists the costs. The latest therapeutic findings and the results of new research are constantly fed into this system so that they can be factored into treatment planning.

Governments mainly use public information campaigns for the population in general and public health consultants for the more deprived classes. Health care has, however, also become a significant issue in the corporate sector. It is normal for employers to ask about lifestyle when interviewing candidates or reviewing employee performance. Wrong answers can constitute grounds for dismissal. “Personnel care” is now an established subset of human resources work and concerns itself with providing optimal conditions for a healthy workforce. Quiet rooms, seminars and coaching on self-management and stress management, and even special health care days are some of the services on offer. The latter have to be taken in lieu of vacation.

2.2.10.4 Do-it-yourself health care

More active patient involvement in prevention and treatment has proved the only way to uphold a system of basic statutory health care. Instead of passively waiting to receive a diagnosis and the appropriate treatment, patients now actively take responsibility for their own health. Institutions commonly known as “health-care-to-go centers” provide people with all the facilities they need to perform “DIY check-ups.” Examples include equipment to measure blood pressure and chips containing “integrated laboratories” for urine and blood samples. If threshold values are exceeded or undershot, these chips indicate that the patient should visit a doctor. Most people have now learned to prick their own finger to take a blood sample, and even to give themselves an ECG. Those who still feel unable to do so can pay a fee for assistance from trained staff who are present at set times.

Patients gain access to the equipment and chips in these health care-to-go centers by swiping their health care cards through a reader. Each service provided is coded and debited directly to the health insurer.

These centers also give a large measure of self-determination back to chronically ill patients. Diagnostic microchips embedded in plasters or even items of clothing measure certain values at regular intervals. The findings can be printed out at terminals in the health-care-to-go centers. Again, values that are too high or too low indicate that a visit to the doctor is in order.

2.2.10.5 In-patient treatment outsourced to the home

Health care costs have been further cut by halving the average number of days that patients spend in hospital. Telemedicine is the key reason why widespread fears of a deterioration in quality have proved unfounded. Patients are sent home in the non-acute phases of an illness. But biosensors embedded in their clothes or sanitary facilities, or even implanted in the body, keep track of developments.

These sensors are linked to an alarm system for both the patient and the doctor. Alarms are triggered if threshold values are exceeded or undershot. Medical implants release drugs at regular intervals or regulate physical functions.

Nursing care is available to sick people for a defined period. Since medical systems have substantially eased the strain on both in- and out-patient nursing staff, the latter can now devote far more attention to the patients themselves – an important factor in ensuring rapid recoveries. Home care requires a large number of ambulant nurses and also offers attractive working hours, thanks to the use of telemedicine. A vast labor market has thus grown up in this segment of the health care sector. Thanks to telemonitoring facilities, sudden infant deaths and embolisms in the context of cardiovascular diseases now only occur in a few technologically underdeveloped regions of Europe.

2.2.10.6 E-health

Information about patients is stored in the form of electronic patient files in a comprehensive database that contains all diagnoses and prescribed courses of treatment. The files also list all the results of visual examinations and the findings of laboratory tests. The same information is also stored in a chip on the patient's own health care card and can therefore be viewed by every doctor who treats the patient. This prevents the wasted time and cost of duplicate examinations, and also involves less stress for patients themselves.

Mature and now affordable video conferencing systems enable doctors to consult with colleagues, present electronic patient files and obtain a second opinion if they are uncertain about a diagnosis. Since this practice initially led to severe bottlenecks, teleconsulting firms now specialize in certain lines of medicine and provide professional second opinions to doctors. Similarly, patients who would like advice from a neutral third-party can contact medical consultants who offer their services over the phone or Internet. Patients have to pay for these consultants' time out of their own pockets, however.

Video phones and PCs fitted with cameras are replacing both visits to the doctor and house visits by doctors. The quality of diagnoses has remained constant. The only difference is that the consulting phase takes slightly longer compared to a personal visit.

Additional cost cuts have been realized thanks to widespread use of e-pharmacies. Elaborate portals and interactive catalogues have been presenting stiff competition to local pharmacies for some years.

Hospitals, too, now use digital channels to order medicines. In-patients carry their electronic patient file in a barcode label on a wristband. The contents can be projected onto a display so that doctors doing their rounds can enter prescriptions immediately and have these sent (via WLAN) straight to the pharmacy. Digital ordering has cut in half the time it takes to deliver drugs to hospitals. Mistakes due to incorrect patient names and illegible handwriting have also been reduced to a minimum.

2.2.10.7 Health care quality management

Medical treatment and psychotherapy are now monitored by an efficient quality system. Quality management revolves around work with the MediExpertSystem. Based on details of symptoms and other patient data, this system produces a diagnosis, requiring certain examinations to be performed if anything is unclear. The system maps the findings of these examinations onto a given clinical condition and suggests appropriate treatments. These suggestions are linked to details of who will bear what proportion of the costs. The likelihood of therapeutic success is also displayed. After every course of treatment, doctors therefore have to enter a cost/benefit analysis in the MediExpertSystem and also pass this data on to the health insurers. In some cases, doctors prefer not to mention complications and problems during diagnosis and treatment. They do this to conceal the fact of unsuccessful treatment, or sometimes just to avoid having to enter lengthy explanations of why a certain treatment did not produce the desired results. Either way, the patients are the ones who suffer as a result.

Heavy regulation by health insurers is also producing further negative consequences: Lack of professional freedom coupled with the increasingly technical and business-oriented nature of the profession mean that fewer and fewer young people now want to become general practitioners or resident physicians. Instead, ever more independent medical consultants are coming onto the market.

2.2.10.8 New methods of treatment

Alongside a strong focus on preventive medicine, research into medical engineering (based on the deciphering of the human genome in 2002) has made tremendous advances in the past decade. Medical science is poised to create a chip that will recognize a person's individual gene profile. This information will enable people to align their lifestyle with their personal gene profile. In the near future, it will even be possible to replace genes that are responsible for diseases with healthy genes. This development will slash the incidence of certain types of cancer, diseases of the immune system and cardiovascular complaints. Moreover, individual genetic analysis can accurately predict the impact of a particular drug on a given individual. Medical treatment can thus be "made to measure" in a very literal sense. A number of crucial benefits will ensue: generally lower costs; less side-effects from cytostatic agents; and a vastly improved quality of life even in the face of cancer treatment.

2.2.11 Eating habits

2.2.11.1 Organic foods

Initiatives launched by both the EU and individual European countries have sought to promote sustainable resource management. Consumers too are better-informed these days. Together, these two forces have driven greater demand for organic foods. Supermarkets therefore display impressive assortments of "bio-foods." Numerous small organic food stores have joined forces to build extensive chains that are thus able to compete with the traditional supermarkets.

Biosensors are used to perform real-time analyses of food quality. Practically all larger supermarkets now operate these systems. Since it is also possible to trace where, how and when food products were made and how long they spent in the logistics chain, consumers have a valid basis on which to decide whether or not an item meets their requirements. Many supermarkets that sell organic foods source their products with hand-picked and therefore trusted suppliers. They also maintain permanent contact with these producers to ensure consistent quality. Exhaustive point-of-sale documentation about suppliers and their products has proved a powerful way to foster consumer confidence and communicate the authentic nature of the products sold.

Local providers of regional products have staged a highly successful comeback with their “unbeatable freshness” claim. There are two main reasons for this success story: Since food shipments began to cause huge traffic snarl-ups and severe pollution all over Europe, the EU has thrown its weight behind local production and local consumption. At the same time, consumers have become more aware that local produce contains more vitamins and nutrients than food flown in from distant places.

Organic foods have also discovered an extra niche that has boosted their market share. Organic convenience foods are much in demand among professional people who spend long hours at work but still pay attention to a healthy diet. This trend has likewise been picked up by many fast-food chains, who today offer a wide selection of organic meals.

2.2.11.2 More is not always better

The trend to apportion food more moderately continues unabated. “Quality, not quantity” is the motto for everything from instant meals to menus in restaurants. In everyday contexts, people also give precedence to simple foods and meals. Regional cuisine, too, is coming back into fashion. “Simplicity” is understood here to mean that foods are consumed without either additives or complex processing stages, i.e. as naturally as possible. In the same vein, recipes have tended to become simpler, with less elaborate sauces and fewer ingredients.

Wholesale campaigns by health insurers and governments to combat obesity have borne fruit. The rampant spread of diabetes 2 over the previous 15 years had made this an urgent imperative. Europe in 2020 has fewer overweight children and adults, despite the fact that the fast-food boom in Eastern Europe is slowing this positive development to some extent. In Eastern Europe, demand for traditional fast food is higher than in Northern and Western Europe, where fast-food chains have responded to shifts in demand by offering more healthy alternatives. Healthy eating is taught from kindergarten age up. Meanwhile, schools and canteens now only serve healthy foods at higher prices – which people seem more than willing to pay.

Governments underwrite basic provision for everyone, so no-one in Europe needs to go hungry. Even in peripheral regions such as Eastern Europe, the redistribution of surplus food from Europe's economic heartland ensures that there is enough to go round.

2.2.11.3 The ritual of cooking meals

Cooking one's own meals, trying out new recipes, and doing this among friends and acquaintances, in get-togethers and at dinner parties, has become something of a ritual. This development lines up with the wider "homing" trend – the urge to transform the home into an oasis of wellness and social enjoyment with family and friends. People are once again willing to take the trouble to prepare their own food, especially on weekends and in their leisure time. Self-baked bread, for example, remains extremely popular. Eager to look after their bodies, people willingly invest the extra time.

Cooking is a prestigious activity for all kinds of people. High-earners and childless couples in particular attend luxury cooking courses, cooking lounges and cooking parties. Designer foods and exquisite delicacies are prepared at these occasions – and then consumed by the whole group along with quality wines specially selected to accompany each course.

2.2.11.4 Slow food

The popularity of the fast-food culture peaked some years ago. To some extent, it has now been replaced by a slow-food culture as people consciously take the time to prepare and enjoy their meals. The transition from functional food intake to elegant culinary enjoyment has been consummated. Unlike the situation only a few years ago, when speed was of the essence while people watched TV or talked on the phone, eating has again become a pleasurable activity in its own right.

This rediscovery of pure enjoyment aligns with people's desire to sharpen their senses. Today's generation is keen to consciously smell, feel and taste; and eating is part of this sensual experience. Sharing such experience with others is equally important. Invitations to dinner are therefore an integral part of this culture of enjoyment.

2.2.12 Education

2.2.12.1 Cultivating knowledge

The process of harmonization within the EU is nearing its end – a fact reflected in the education systems operated by member states. Diplomas and education certificates, for example, are now recognized throughout Europe. Governments provide a guarantee of equal opportunities for all social strata. And the public funding of education has remained largely stable. State subsidies for new didactic methods and technologies in schools and universities have prevented the emergence of a digital divide.

Knowledge is growing exponentially in today's globalized world. But people are reaching the limits of their capacity to assimilate purely factual knowledge. Knowing how to generate knowledge and who to turn to with questions has thus become all the more important. The ability to filter relevant information from the daily deluge of data and then quickly decide what to do with it has become criti-

cal to professional performance. Experiential knowledge (answers to the why, where and when questions) also plays an important role. Working life is hard for people who do not master these skills. Struggling under the burden or information overload, they find themselves unable to distinguish the important from the unimportant.

2.2.12.2 Educational content

These days, educational content is closely linked to technological and corporate development and to social change. The overriding educational objective is to “teach people to learn,” i.e. to help people to handle complex content issues and learn to reduce complexity. Independence, teamworking, communication skills, intercultural skills and creativity are likewise anchored in curriculums, because they are recognized as vital attributes in the context of working life. Instead of merely being led passively, children are now given more freedom to grow actively.

Inter-class projects and hands-on internships in the corporate sector and/or in charitable work are helping schools to become veritable “community learning centers” and, as such, a core aspect of local social life. High priority is attached to instruction in ethical standards. Schools are therefore assuming more and more responsibility for teaching values and norms. To some extent, they are thus substituting for the traditional moral educational role of the family. For many schoolchildren, today’s more practical approach to teaching has made the transition from school to working life far smoother than it used to be.

Full-day schooling, now the predominant form all over Europe, helps pupils from all social strata to learn to live together. Homework supervision is also provided, as is access to the school’s IT infrastructure. With society becoming ever more multicultural, what are known as “integration pre-schools” help children from other countries to learn the local language and become integrated in the local culture. This makes life easier for them when they start school.

2.2.12.3 Quality management in education

Implementation of the Bologna Process, initiated in 1998, has made more equal opportunities available to schoolchildren and students, helped overcome obstacles to mobility, and increased the number of students who enroll for masters' degrees.

The PISA study conducted at the beginning of the century had similarly far-reaching consequences. Europe's economic heartland has since learned and benefited from the example of the Scandinavian school systems. One example was Sweden. The PISA study rated this country's school system as the most democratic in Europe. Assistance is provided to help children from underprivileged families to do well at school. No-one ever has to repeat a year. And, in many places, grades are only awarded in the last few years of secondary education. Furthermore, Swedish schools are very free in the choice of the subjects taught, as the objectives laid down in national curriculums are consciously formulated in a very general way.

Universities in Northern Europe and the continent's economic heartland today benefit from the presence of foreign researchers, lecturers and students, as they do from the input of those who have gained experience abroad. Every year, an independent commission publishes a list ranking Europe's schools and universities. These rankings are the standard reference work for young people choosing where they want to study. Teachers and lecturers are rated by pupils, students and parents (as part of a 360° appraisal policy). This practice has yielded substantial improvements in the quality of education. Teachers regularly attend development seminars to learn motivational, team-building and leadership skills. They also take courses in therapeutic disciplines to compensate for deficiencies in parental education.

Even the way teachers are recruited has changed. Today, experts from business, industry and the public sector serve as part-time teachers to help give children an all-round education and help them make informed decisions about their choice of career. Retired professional people do the same either free of charge

or for a nominal fee. Intergenerational learning has gained a firm foothold at schools and universities. It is generally accepted that the challenges of the future can only be overcome if the younger generation can articulate its desire for change and express its will for change, and if the older generation can bring its experience to bear, engaging the former in constructive dialogue about what has to be done differently.

2.2.12.4 Educational organizations

Europe's educational organizations have risen to the challenge of life-long learning. They have become more professional and now offer focused training and development modules. They compete both with each other and with a large number of firms that specialize in this field. Specialized universities of applied sciences and professional academies have also gained ground. These establishments very effectively respond to the demand for practical tuition by combining in-company training with scientific study.

At the same time, alternative educational institutions are growing at a remarkable pace. This is because many parents set great store by holistic personality development for their children and actively seek to encourage creativity, communication and independence. This phenomenon is especially widespread in Eastern Europe, where higher-income families, having shaken off the educational restrictions imposed by Socialism, are now benefiting from the economic boom and showing a great interest in this approach to learning.

2.2.12.5 Copyright protection

Intellectual property continues to enjoy legal protection. Publishing and duplication, too, are regulated by law. Changes in intellectual property laws were spawned by numerous violations. Today, access to processed information is often fee-paying. As a result, high quality standards can be maintained and information and knowledge can be continually updated.

2.2.13 Safety and security

2.2.13.1 Crime and terrorism

Threats whose intensity increased in the early years of this century remain a source of uncertainty around the globe. Crime, terrorism and attacks by hackers, plus infections and epidemics that often spread like wildfire owing to global mobility have all greatly reinforced people's perceived need for security and the rule of law. Aware of the need for the state to have a monopoly of power, people actively support all government efforts in this area.

A substantial and very high-profile police presence combines with surveillance systems installed in especially vulnerable areas to demonstrate the efficiency of the government's security activities. They also serve as a powerful deterrent. New technical systems that identify and record deviant behavior and automatically report suspicious behavior to a security service (which is then sent to investigate) have proved particularly effective. An international institution has been set up to keep watch over the Internet, track down Internet crime and trace hackers even to the remotest corners of the Earth.

All this is not enough to prevent terrorist attacks, however. Undercover preventive measures are also needed. Very close collaboration between secret services and anti-terror squads has kept Europe (but not the rest of the world) largely free from this threat. Crime prevention also involves monitoring flows of goods and transport routes. On the latter front, the satellite-based traffic flow monitoring systems originally introduced to levy tolls have made it possible to track goods flows virtually from end to end. Similarly, satellite-based technology allows containers and euro-pallets to be monitored along the entire logistics chain. The same technology also records unusual loading operations and gives the police the chance to fight effectively against smuggling and product piracy. Major logistics firms have advanced the development of this technology. Their aim is to stay in full control of every consignment in transit anywhere at any time, and therefore to be able to notify recipients of the time of arrival with great accuracy.

2.2.13.2 Infections and epidemics

As long as marked discrepancies persist in standards of hygiene and prophylactic health care in different parts of the world, it will remain impossible to stamp out infections and epidemics or prevent them from spreading in a globalized world.

A worldwide data gathering and warning system provides clear indications about countries, places and times that harbor particular threats. The system is constantly updated on the Internet and has proved extremely helpful to well-informed travelers. The ability to distinguish between genuine threats and overblown media sensationalism has helped avoid panic reactions. Close collaboration between government authorities and the pharmaceuticals industry has likewise proved exceptionally useful. If the need arises, codes of practice can be drawn up, new medicines developed and vaccination campaigns carried out in a very short space of time.

2.2.13.3 Harmful substances

This virus and epidemic information system is complemented by a series of systems to track harmful substances in the environment. The systems detect substances that have leaked as a result of accidents, for example. But they also continually measure the concentration of pollutants in the soil, water and air. These measurements also make it possible to monitor the environmental origins of foodstuffs more efficiently. For instance, readings can be used to identify the extent to which soil complies (or fails to comply) with the regulations governing organic agriculture.

The farm industry in general is now far more circumspect in its use of fertilizers and pesticides. The annual environmental damage report shows that the quality of air, water and soil is constantly improving. Two further reasons for this improvement are Western Europe's transition to a service economy and the introduction of more modern production facilities in Eastern Europe. The latter emit far less pollutants than their predecessors in Europe's economic heartland.

3 Scenario 2 – Life in the year 2020

3.1 General situation

3.1.1 The economy

The whole of Europe has experienced a pronounced upturn in the economy. In the year 2020, economic growth is being driven primarily by the corporate sector, which has achieved substantial efficiency gains by focusing rigorously on market economy principles. The lifting of constraints on free market forces, the advanced state of globalization, and the lack of interventionist government have succeeded in fostering moderate economic growth and in leveling out differences in the gross national product across countries in Europe.

The prime mover powering this economic growth is Europe's marked lead in knowledge and expertise in such areas as product development, production methods, and process management. Businesses have managed to boost productivity on such a scale that Europe has succeeded in cementing a strong position as an industrial location in spite of the global challenges issuing from recently industrialized nations like China.

Now that businesses are concentrating on delivering quality and on managing their relationships with customers, employees and suppliers efficiently, prices are generally high but so is the level of service.

In the past two decades, the services sector has grown increasingly important, bringing forth a raft of new, intelligent forms of service that are in high demand, not just among businesses but also among private individuals. Most new jobs have been created in the field of information acquisition, information processing and information distribution. The services sector is benefiting from the large spread of incomes across society. Wealthy private individuals can purchase services such as childcare, household help, and even personal coaching and fitness consulting relatively cheaply. This trend is drawing additional momentum

Scenario 2 – Life in the year 2020 – The economy

from the fact that services for private households are now tax-deductible. This means that moonlighting for cash is no longer as attractive as it was and that GNP has risen as a result of the decline in the black economy.

These changes have caused certain local and government services, particularly in the social sector, to fall into neglect, leading to considerable tensions across society. In 2020 there is an enormous disparity between rich and poor. Although sustained economic growth and a high employment rate have led to a marked increase in many households' disposable income, there is a significant number of people who, due to the lack of a sound education and today's tougher requirements and expectations in the labor market, has to survive on little more than the minimal living wage.

Although people are having to pay more out of their own pockets for health care, retirement provisions and, increasingly, personal security, the resources available within the population for private consumption have actually increased on average during the course of the last 20 years.

The labor market is highly flexible. Businesses work with a core workforce of regular employees, plus an ancillary workforce on freelance contracts. This allows companies to adapt quickly to shifting capacity requirements, to reduce the burden of fixed overheads, and thus to achieve greater profitability.

Individuals who can achieve recognition as specialists in the labor market or who have qualifications that are in high demand can exploit the market's new-found flexibility to organize their private and working lives around their personal perceptions and preferences. For example, they can tailor their work time models to suit the needs of their family situation. This shift in the job market has also led to women playing a far more important role in the economy and society than was the case 20 years earlier.

Scenario 2 – Life in the year 2020 – The economy

The flexible labor market – in combination with rising life expectancy – has caused the retirement age to rise to almost 70 years. However, people commonly punctuate a working life this long with a number of breaks – either for continuing education and training or to devote time to personal growth experiences.

The changes in the labor market have diminished the strength of people's ties to employers and places of work, with the result that they change jobs more frequently and think nothing of working at different locations around the world or from home as well as in the office. This new caste of global job nomads are people who have chosen to pull up their roots and move from their home countries to new places to live or work several times during the course of their lives.

To encourage employees to identify with their companies in spite of this new flexibility, employers today actively seek to promote employee loyalty where they can. From a business perspective, employee commitment is no less important than, say, customer loyalty or shareholder value have been since the 1990s. Given that every one of these relationships needs constant care and attention so as to minimize the risk of a sudden shift in loyalty, stakeholder management has emerged as an area of considerable importance.

Companies today face the challenge of managing constant change – a situation that calls for a short-term business mindset. Investments, for instance, are gauged on how fast they produce a return, and the only areas in which thinking tends to be longer-term are those that involve no sizeable commitment of capital.

Product innovations born out of long-term development programs often are not profitable, because it has proven impossible to establish a Western-style perception of the sanctity of patents on a global scale. Patents therefore enjoy scant protection, and in many cases, copycat products end up raking in the real profits. Thus, key innovations tend to emerge frequently in the area of manufacturing processes, where they help to raise profitability. This is where Europe secures its lead in industrial expertise.

Scenario 2 – Life in the year 2020 – Politics

With shorter-term development programs – aimed at taking new products to market rapidly or adapting existing products to new requirements – the situation is altogether different.

Products tailored to current and often very short-term needs are embraced by markets extremely quickly. One prominent case in point is the mobile phone and its rapid metamorphosis from an instrument of voice communication to an integrated data terminal, complete with a built-in camera and TV receiver. Here, high-quality, consistently innovative design plays a major role in consumer take-up.

This trend has led to a sharp distinction between standardized, mass-market products and high-quality luxury goods. Aside from the aforementioned innovations, one of the driving factors is the substantial difference in income levels across the population, which has segmented the market into discount goods aimed at consumers with low incomes and high-priced brand-name articles for the more affluent.

A pronounced brand awareness has grown up throughout society as consumers seek to leverage brands as status symbols. As a consequence, brand management has become increasingly important for businesses, and reporting brand value as an asset item on balance sheets is now common practice.

3.1.2 Politics

By and large, governments have withdrawn from any immediate involvement in industry and now concentrate on sustaining the right economic framework for business. In Europe, former state-owned companies have now, for the most part, been privatized.

State bodies and organizations have yet to succeed in implementing a functioning collaborative framework at the community, regional, national and European

level, so every issue arising is processed by at least two or three separate tiers of government due to overlaps in tasking and responsibilities. This bureaucracy constitutes an annoyance for companies but ultimately has little impact on their freedom of movement.

Nation-states have retained their sovereignty, with the result that European institutions remain broadly reliant on their assent. The influence of the European Parliament therefore remains limited.

Due to a lack of international collaboration and coordination, governments have failed to ensure the security of their citizens, and international terrorism and attacks by hackers continue to pose a general threat. This failure by the state has led to the emergence of private operators specializing in security services.

At the international level, the United Nations offer a counterweight to the decline in states' power by acting as a central mediator in international conflicts. The organization now enjoys greater financial independence and has the power to take action, albeit to a limited degree.

Viable world trade agreements are now in place – thanks in no small part to the fact that nation-states no longer consider it their duty to represent the interests of national business enterprise and now leave companies to their own devices. These agreements and the free trade zones in major economic areas in Europe, the Americas and Asia are helping industry to thrive.

There is now an open world order in which Europe, rather than set itself apart, works as a uniting force and derives the strength to do so from a common European history, culture and attitude toward life.

During the past 20 years, the importance of intermediary institutions has diminished substantially, and political parties have ceased to shape informed political opinion to any significant degree. Instead, NGOs (whose membership now fluctuates rapidly) serve to represent the interests of citizens and are now formally

Scenario 2 – General context – Politics

involved – for the time being at least – in those decision making processes that pertain to the issues they champion. Prominent experts and figures from public life work actively in these NGOs at the local and/or international level.

At the local level, citizens' initiatives and self-help groups have widened their sphere of influence. They, too, play a prominent part in problem-solving processes – something evident from the large number of referendums and public votes now held. This trend toward direct democracy is gaining additional momentum from the fact that an increasing number of holders of executive and public office are elected directly by the populace. As a rule, public officials are now elected directly.

Like the political parties, the trade unions have seen their strength and influence wane. They have gradually been worn down by their inability to reconcile the specific interests of individual occupational groups, and they have failed to unify and focus interests in such a way that they could represent a serious negotiating partner for companies. A large part of their former influence has devolved to occupational groups and to employee representatives within companies. Parallel to this, works councils have gained ground and now wield more power in large corporations than before. They are also just as international in structure as the companies in which they operate.

The trade unions' counterparts on the employers' side – the employers' and industry associations – have outlived their usefulness. Businesses today represent their own interests, and innovative companies commonly team up to create networks as an alternative to the industry associations – networks through which they collaborate, regardless of their particular industry sector or size.

Media companies are primarily private-sector organizations that have emerged successfully from an enormous process of concentration, a process that has led to a standardization in the supply of information throughout Europe and, above all, commentary on important political and economic events.

The information disseminated by the press, television, radio and the Internet is now almost identical. The media is controlled less by the world of politics or industry and more by NGOs, citizens' initiatives and federations organized on less formal lines. The World Wide Web is just another communication channel available to the media; it also provides every individual with a platform on which to spread and share his or her own ideas, thoughts and creative outpourings through web logs. The Internet's steadily expanding importance has actually given rise to several different webs during the past ten years. Besides cataloged and professional editorial content, the network also carries a vast amount of less meticulously prepared material, with the result that it can be difficult to distinguish between reliable and inaccurate information.

3.1.3 Environment and infrastructure

Governments have privatized their services to the greatest extent possible and today attend to just a limited number of sovereign duties.

In education and in health care, the state provides just a basic and essential level of service. In both these sectors, former state services have now been outsourced to private operators, creating two prosperous new industries. Large, international companies specializing in education today provide not just general schooling but also higher education and onward training as part of a product offering spanning everything from kindergartens to mass and elite universities. This privatization process has led to a marked rise in private expenditure on education.

Parallel to the state-guaranteed, relatively affordable basic education, private companies offer education services in a wide range of standards and price categories. Thus, access to education is a function of a person's social class and, ultimately, the prerogative of a more moneyed clientele.

Scenario 2 – Life in the year 2020 – Environment and infrastructure

The sizable differences in income across the population between rich and poor have created a widening education divide, as those who are eager to receive an education and can afford to pay for it are far better trained than those members of the population who cannot (or choose not) to spend money on schooling.

Besides encouraging competition, this transformation of education into a for-profit system has also given rise to a variety of types of qualification. Experimentation and transformation are both hallmarks of the education system throughout Europe. However, this variety often proves to be disadvantageous when changing providers. At the same time, though, education providers operate internationally, making it easier to stay with the same one but to switch to tuition programs in another region or country. Differences in school-leaving qualifications between one country and the next remain one of the greatest hurdles in the way of successful international harmonization of education.

Due to the increasing importance of education, companies, too, are investing more than at any time previously in employee training and education programs.

In the transport sector, the situation is altogether different than in education. Given that mobility has become a crucial competitive factor, governments are financing transportation infrastructure — roads, rail lines and airports — as a means of fostering and sustaining economic growth. However, private operating companies are responsible for running and maintaining the transport infrastructure.

Another fundamental and, indeed, indispensable need alongside mobility is constant accessibility at any time of the day, both at work and after hours.

The health care sector, too, has experienced a sea change as good health has advanced to become not just one of the most important values but also a status symbol in an increasingly elderly society. People are willing to spend a considerable amount of their income on health. Publicly run organizations are gradually being superseded by private companies, which, during the past ten years have developed into full-blown health care conglomerates. Besides investing

Scenario 2 – Life in the year 2020 – Environment and infrastructure

in research and development and the manufacture of drugs, these conglomerates are also funding the development of new methods of treatment to deliver to the health care market. Their offerings therefore include a wide variety of high-technology treatment and diagnostic methods. The population's widening knowledge of different cultures and healing arts (everything from Far Eastern medicine and homoeopathy to genetic engineering methods and techniques) is promoting greater use of the entire offering available.

Increasing integration between regions as a function of globalization is causing new and previously unknown medical conditions to emerge constantly, making it increasingly difficult for the health care sector to diagnose conditions quickly, to develop effective drugs and treatment methods, or to protect the populace against infection.

Due to the large-scale privatization of health care, medical research is aligning with market considerations. This means its focus has shifted to the uppermost, wealthy market segment. Thus, a large part of the population has no access to new and advanced offerings and must satisfy itself with the modest standard of health care provided by the state.

The rising demand for natural resources has triggered a race among major nations to secure as much of these for themselves as inexpensively as possible. Today, these resources are primarily viewed from an economic standpoint, with the result that prices are dictated by supply and demand. This means that smaller, less powerful states are constantly at a disadvantage because they are ill-equipped to compete with the larger nations that rule the marketplace.

Business is therefore dominated by short-term, purely commercial thinking that precludes any form of sustainability or forward-looking action. For example, no precautions are taken to soften the blow of the climate changes expected in the longer term. Problems are only addressed when they take on such a scale that they warrant urgent and immediate action.

The situation in the area of food production is broadly similar. Here too, the battle for world market share has begun. Outside Europe, food is available in just limited quantities and is already in considerably short supply in some of the world's regions.

Consumers expect foods to be both high in quality and inexpensive. Whether or not foodstuffs are produced organically, traditionally or with the aid of genetic modification remains a secondary consideration.

Like mineral resources, water, too, is being privatized to an increasing degree. A number of corporations are operating as global "utilities," which means that the requisite financial resources can now be committed to developing the water supply in deprived regions. Governments simply play a watchdog role. Regulatory authorities similar to those responsible for infrastructure services such as telecommunications and the mail ensure that all of the population has access to a supply of water at an appropriate price.

3.1.4 Technology

Society is exceptionally open to new advances in the technology sector. Above all, those technologies that promise quick returns have succeeded in becoming firmly established in the marketplace.

Technologies involving sizeable initial investments or lengthy development processes have succeeded only to a limited degree. Fuel cells, for example, have yet to achieve the desired breakthrough, as the only units to have been deployed are in stationary rather than mobile applications and are often subsidized installations.

The situation in the nuclear energy sector is different. Cheap power generated by nuclear means, the development of inherently safer generating technology and Europe-wide efforts to reduce CO₂ emissions have led to a renewed upsurge in

nuclear energy. In part, this has come about because the European market has become more close-knit. The industry has succeeded in finding suitable sites for nuclear power plants and the final disposal of waste in regions that would otherwise not attract investment and are less wary of the technology than are the countries in Europe's economic heartland. Large interconnected grids are in place, ensuring that sufficient power is available throughout Europe and that the growing energy requirements of a society increasingly reliant on technology can be covered at a fair price.

Advances in communications engineering are having the greatest immediate influence on day-to-day life. E-commerce has become one of the most important sales channels. The electronic purchase of goods and services, electronic payment, and even electronic logistics and dispatching are now everyday processes in the supply sector. In experiential retail, e-commerce and bricks-and-mortar retail outlets complement one another extremely well and to mutual advantage.

Intelligent, autonomous systems accomplish a whole string of tasks in private households and in the work environment – everything from the distribution of consumables to automatic implementation of security safeguards. Since governments are no longer able to guarantee security, demand among private individuals for new surveillance and identification technologies is on the upswing. Thus, security has advanced to become an important market in its own right.

The mobile communications sector has succeeded in marketing attractive services for business users and consumers based on mobile broadband.

Ubiquitous communication has become the rule. Many everyday items in the home and in the workplace are now both “smart” and networked. In the logistics sector in particular, information on the location and condition of goods is used to monitor manufacturing quality and supply processes, as well as to improve customer service.

Scenario 2 – Life in the year 2020 – Technology

Access to electronic means of communication, and the ways in which these means are used, creates advantages for some sections of the community (cosmopolitan and informed individuals, people in employment and young people equipped with good start-up opportunities) over those without such access. The consequence is a digital divide within society.

Automatic translation systems have failed to become established, because the primacy of English as an international lingua franca means that a large number of people are able to communicate directly with one another. Quantum computing likewise has yet to achieve any kind of significant breakthrough.

One major milestone in electronic communications has been reached with the Supranet, the network of the future. It consists of multiple, self-organizing networks in which the terminals themselves are the network nodes. Data transmissions and phone calls can find their way from terminal to terminal without having to rely on centrally managed networks. This has played a major role in minimizing the cost of communication and information and has been instrumental in substantially increasing data transfer and communication volumes.

Technological advances in the food industry have led to an increase in genetically modified produce and products. These are appropriately marked and have become established on a broad scale in the marketplace, not least on account of the lower price.

As to genetic engineering in general, Europe has yet to achieve consensus on what is regarded as ethical and legally justifiable and what is not, with the result that different regions in Europe are locked in intensive competition to become the foremost locations in this field of expertise. Above all, smaller states like Estonia and Iceland have succeeded in carving out an advantage for themselves by enacting less restrictive laws.

Important advancements in the use of human and animal tissue and organs have been awarded patents that secure corporations the rights to certain forms of therapy and operative procedures. Because these companies themselves operate

hospitals, they are able to offer these services at affordable prices. However, they have not succeeded in securing comprehensive protection for their patents.

The medical profession now makes use of the entire gamut of technologies capable of influencing human life prior to birth. Prenatal embryo selection with the aim of avoiding genetically based diseases and in vitro fertilization, a procedure originally developed with the goal of helping infertile couples to have children, now make it possible, up to a point at least, for parents to fulfill their personal wishes as to the character and genetic makeup of their unborn children.

Cell surgery emerged as a significant technology, demonstrating how cross-pollination between different scientific disciplines can bring important benefits for humankind. Previously incurable diseases such as certain forms of cancer have become curable as a result.

3.1.5 Social values

Societal transformation is regarded as positive, and society in general has an open attitude toward change. However, there are no generally binding or uniting values any more. Individuals, businesses and organizations alike constantly seek their own advantage. Self-realization and self-responsibility are located at the very top of the hierarchy of values. Every individual is responsible for his or her personal wellbeing, ongoing development and conduct. Every human being also has the right to choose to die and to transfer the power to make that decision to those close to him or her.

The principle of self-responsibility also extends beyond the private sphere to the workplace, where employees are expected to be proactive and entrepreneurial in the way they approach their work.

People have an open attitude toward the entire world and eagerly make use of the fact that they can travel wherever they wish to share and exchange ideas

Scenario 2 – Life in the year 2020 – Social values

with others. Contact with other cultures is something people have long since taken for granted, something that has fostered a multicultural society in Europe enriched by a broad diversity of lifestyles and senses of values.

The divide between rich and poor has grown wider because one part of the population generally benefits from the economic developments in Europe and has been able to increase its income still further, whereas other parts of society have not. The differences between rich and poor are not just evident from one European region to the next, but also within individual countries.

The differences issuing from this divide extend beyond living standards and consumption to include time, which has advanced to become a status symbol. The difference between the “time poor, money rich” and the “time rich, money poor” is one of the key distinctions defining social strata.

People’s standing in society depends heavily on their choice of leisure activities and on their involvement in political and community life. Those who are heavily committed to building their careers tend to participate to a greater degree in politics and society and are more active in their free time.

Social strata have become more permeable than ever before, with the result that it is easier for individuals to rise through the strata than it was 15 years earlier. However, this greater social permeability also carries with it a risk of loss of social standing, because a person’s social status is no longer set for life.

The immense openness toward new technologies and the rapid progress in information and communication engineering have helped to promote the emergence of virtual worlds as a new form of lifespace. These virtual worlds are regarded as an enriching and complementary environment alongside the real world and as an opportunity for some people to escape from their perhaps less appealing everyday lives.

3.1.6 Demographics and social structures

Europe's society is ageing. Due to the influx of immigrants from all over the world, however, population levels and the age-group structure have remained more stable than originally predicted 20 years ago.

Society is tolerant, accepting a wide variety of styles of living, and affords individuals the freedom to choose how they wish to lead their lives. The principle of the nuclear family is no longer as important as it was. Combining a career with raising a family remains easy, particularly for the wealthy, who can afford to pay for such services as childcare and household help. In a society that defines itself on achievement, the social differences are becoming more and more pronounced, and the poor are growing in number; some even have to subsist on less than the minimum living wage.

The search for employment opportunities has caused urbanization to increase and the rural population to decline. This trend is gaining momentum as industrial companies all over Europe migrate to cities and peripheral areas.

3.2 Life in the year 2020

3.2.1 Lifestyle

3.2.1.1 Fuzzy society

The pace of life is accelerating constantly and society's structures are becoming increasingly amorphous. Social cornerstones – romantic partnerships, people networks, communities of interest, and even companies and co-worker groups – are changing faster all the time and are seldom constants in the life of an individual. Citizens' initiatives and NGOs pursuing short-term agendas (and prone to sudden changes in objectives and sharp fluctuations in membership) have supplanted the political parties and communities of interest, which tended to maintain a longer term focus.


Romantic partnerships and working relationships are formed for nonspecific periods of time rather than on a lifelong basis. It is not exactly clear who belongs to which interest groups or what the exact distinguishing characteristics of these groups are. In companies, the distinctions between the core and ancillary workforces are hazy. Employees are frequently unaware at any given time whether the colleagues on their team are regular employees, permalancers or freelancers, or how long they will be working together. Relationships with friends, acquaintances and people who share the same interests are often far more distanced and informal than in the past. The younger generation decides spontaneously on how and with whom they spend their leisure time. Life is full of risks, and individuals' behavior is often spontaneous, their life choices frequently exhibiting no evidence of planning, not even in the intermediate term.

3.2.1.2 The egocentric society and the society of opposites

All of these uncertainty factors present individuals with challenges that would have been unthinkable not all that long ago. Every person is responsible for his or her life and relationships with partners and friends; every individual has to

create and nurture his or her own personal network. Anyone who does not can soon end up isolated and lonely. Also, everyone must define their own set of values. This has far-reaching consequences for the state of a society now shaped primarily by individualism.

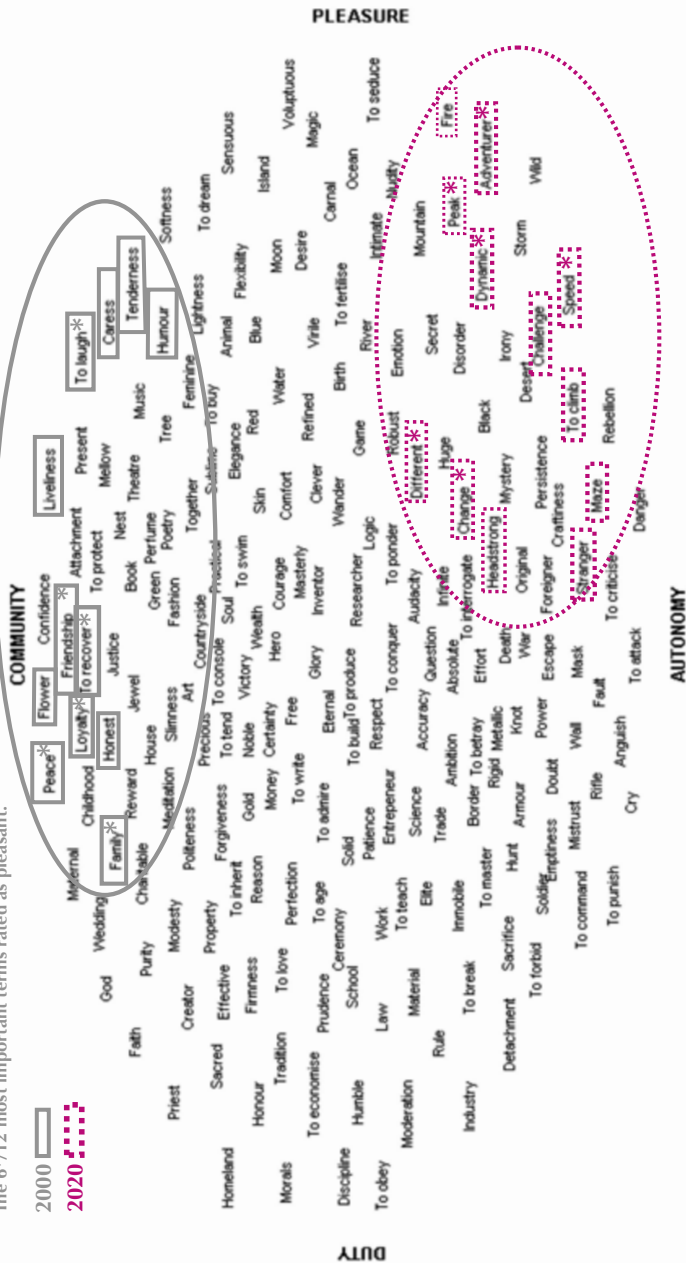
The so-called semiometry model created by J. F. Steiner to describe the state of a society (as well as other, smaller groups) defines a space around two axes – one running between the poles of duty and pleasure, the other between community and autonomy – containing 210 separate terms identifying characteristics of society (see page 35 for a detailed description of the methodology). A number of important surveys conducted in Europe between 2001 and 2003, which provided valuable information relevant to a better understanding of societal trends, reveal that, during that period, words like peace, friendship, family, loyalty, to recover, and to laugh were among those that occurred most frequently and formed a cluster around the community pole, reflecting the predominant mood of the day. Today, in 2020, the spirit is altogether different, as current surveys accord topmost priority to terms like adventurer, peak, speed, change, different and dynamic. These are generally grouped closer to the autonomy pole, which distinguishes and characterizes today's prevailing sense of life (see the figure on the next page).



From Community to Autonomy

The 6*/12 most important terms rated as pleasant.

2000 
2020 



The transfer of responsibility to the individual has led to a society marked by extreme opposites. Society is breaking down into rich and poor, into those for whom achievement is paramount and those who place more value on leisure. At no time previously has the divide between the “time poor, money rich” and the “time rich, money poor” been so pronounced as it is today. But differences in access to education and health care, too, have led to a sharp split in society. There are those with no interest in learning and those committed to lifelong learning; there are the exceptionally well informed and the uninformed; and there are the physically fit and the ailing. These differences may be attributable in part to the lack of opportunity, but none too seldom, they are also due to individuals’ inability or lack of desire to face up to life challenges head-on.

Whether or not and to what extent individuals are at home in the digital world is an important determinant shaping the world they live in and their ability to reap the rewards that life potentially offers. This society of division – into those who are engaged and those who are disengaged – is not static, however. It is more permeable today than ever before. The winners in society today can easily be among tomorrow’s losers. And the situation can be reversed again a day later. Social standing is no longer a constant but depends on what individuals do with their lives and the opportunities they elect to grasp.

In this society of opposites, there are those who remain at anchor in local waters and think in local dimensions, and there are the global elite – some 3–5% of the world’s population, or roughly 300 million people – who are essentially at home anywhere in the world and who share a common, overarching world culture. They unite across different cultures, religions, and countries of origin; they are the ones who shape the global village, who communicate and debate with one another, who make contacts everywhere, and who work on issues of shared importance and solutions to multilateral problems.

3.2.2 Relationships

3.2.2.1 Romantic partnerships

Active management plays a far greater role in relationships today than it did even just a few years ago. This applies as much to romantic partnerships and friendships as it does to people's circles of acquaintances and their immediate and wider networks of associates.

As the closest and often the most important relationship, the romantic partnership is primarily an association centered on self-realization and achieving shared happiness, enjoying a richly eventful life as a couple, and creating a safeguard against the increasing risks in life, such as the loss of employment, serious illness and the onset of frailty in old age. By contrast, the emphasis on partnerships revolving around raising children or the family's former role as the "germ cell" of society has lessened considerably.

What is unique about modern romantic partnerships is that partners no longer expect their opposite to entirely fulfill their expectations. Networks of friends and acquaintances complement the partnership. People have preferred companions for every life situation, depending on whether they want to take a hiking trip, visit the theatre, play sports or enjoy a stimulating conversation. It is common for romantic partnerships not to have been officially sanctified; instead, people enter into them for a nonspecific period of time and can dissolve them again easily. However, this does not preclude former partners reengaging with one another – and they often do, not least because they often develop a strong and stable friendship in the wake of a separation.

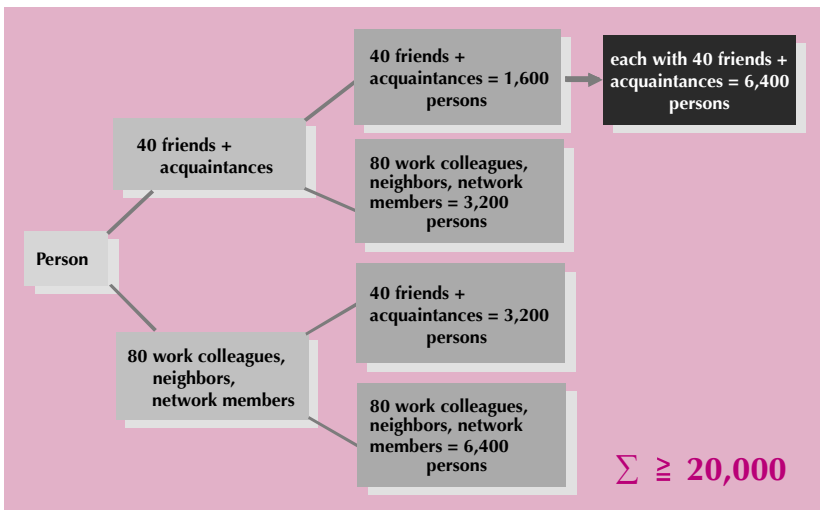
People engage in both opposite-sex and same-sex partnerships, and life partnerships commonly exist in which one of the partners hails from an entirely different cultural background. Friends are often strewn all over the world. This means that friendships exist independently of place and time but also that they require active maintenance.

3.2.2.2 Personal networks

The Internet has a sizeable influence on the number and the quality of a person's regular relationships and on how these relationships are managed. People's relationships have multiplied considerably in number in recent years.

It has always been the case that people everywhere are interconnected through a chain of contacts consisting of six persons, on average. Today, in 2020, people can gain leverage from this network and the potential it offers. For instance, if someone needs help, he or she can turn not just to his or her 40 immediate friends and acquaintances but also to any of their 40 friends and acquaintances, who in turn each have a further four close friends whom they can contact. In next to no time, any of as many as 6,400 people can respond to the call for assistance.

The size of networks



Scenario 2 – Life in the year 2020 – Relationships

People's networks of immediate associates, too, have increased in size. Besides their 40 friends and acquaintances, people know around 80 individuals from groups who share the same interests, from the local neighborhood and from work ($40 + 80 = 120$). Every five friends of one's own friends and acquaintances extend this network to 320 members. If someone sends just two electronic messages to friends each week and the remaining 218 members a message each quarter, at Christmas and on birthdays, this amounts to 5,840 contacts a year, or 16 a day [$(40 \text{ friends} \times 52 \text{ weeks} \times 2 \text{ contacts a week} = 4,160 \text{ contacts a year}) + (280 \text{ network members} \times 6 \text{ contacts} = 1,680 \text{ contacts}) = 5,840 \text{ contacts in total}; 5,840 \text{ contacts in total} : 365 \text{ days} = 16 \text{ contacts a day}$].

In addition, there are personal encounters – four meetings a year with friends and acquaintances and one with roughly one-third of the remaining network. This means 250 personal encounters with members of one's own network, or around five days a week on which one engages in some form of initiative to maintain personal relationships.

But acquaintanceships within a personal network are now substantially less binding. The churn rate is high, and one is never entirely sure at any given time who is still part of the network and who has dropped out again. Through its low level of personal closeness, the network also helps substantially to overcome cultural and class barriers. One unique advantage it affords is the ability to locate and temporarily activate a web of contacts in a specific field whenever needed by means of "i-blogs." Thus, the network opens up entirely new possibilities for forming associations, both deliberately and spontaneously. However, individuals who fail to devote sufficient care and attention to maintaining their network can easily end up isolated, because anyone who fails to communicate actively won't be contacted either.

3.2.2.3 Gender roles

Former sharply delineated societal structures have reached such an advanced state of amorphousness that there is little distinction any longer between gender roles. To a large extent, a third gender has emerged that unites once typically

male and female roles in an androgynous form of behavior. This is evident in the feminization of certain areas of behavior in the majority of men, who today pay a lot of attention to their physiques and their general appearance, and who as a result have been courted increasingly in recent years as a lucrative target group by the fashion and cosmetics industries and by cosmetic surgeons. At the same time, the majority of women have adeptly assimilated types of behavior once more in the male domain, such as decisiveness, assertiveness and the wielding of power.

This gradual softening of distinctions between behavior roles is particularly noticeable for the older generation. The younger generation takes hybridization more for granted because, for the most part, they have grown up in an environment in which loving fathers who invested time in raising their children and engaged in housework were just as much a part as mothers who had to hold their own in the workplace. For this reason, some often yearn to be able to live out a more clearly defined female or male identity. For example, young women who dress in a highly feminine and seductive way or who focus on a partnership or on children without the additional burden of holding down a job are becoming increasingly common. Some men, too, are choosing to play an exclusively male role, exhibiting or reverting to a dominant rather than co-operative style of communication and devoting much more time to their careers than to their partner or their family.

3.2.2.4 Singles

For numerous reasons, many people today live life as singles. It has come to be accepted by society as an entirely valid lifestyle choice as people increasingly take an active decision not to enter into long-term relationships – say, because they have separated from their partner, the expectations they have of a partner are impossible to fulfill, they are career-oriented and have no time to share their life with a partner or they simply cannot find a suitable mate. Today, singles are common in all age groups. Many of them are relationship nomads who, due to their flexible lifestyles, a sense of restlessness, the worry that they might be missing out on something or their essentially self-centered characters, are unable to

Scenario 2 – Life in the year 2020 – Relationships

hold down a relationship for any substantial period of time. They break up with their partners, spend a certain amount of time alone and then seek out a new relationship.

The number of “part-time” singles has also increased to a considerable degree. These are people who have a partner with whom they do not cohabit because they need a large amount of time for themselves and do not want to devote themselves fully to a partnership. The singles society has brought with it a whole raft of changes. For example, singles often choose to share accommodation, a living situation that gives them at least a sense of being under the wing of a family. On top of this, sharing a house or apartment offers a number of advantages over the classic family environment: There is less responsibility involved, and less consideration needs to be shown toward cohabitants. Also, moving elsewhere is not a problem: People can simply leave one shared living situation for another without having to consider their roommates’ feelings. This form of living allows people to live out their sometimes oddball ideas alone or with people of a similar makeup.

In economic terms, singles are an interesting target group because they are often not just strong earners and eager, brand-aware consumers, but are also lonely at times. Thus, agencies specializing in finding potential marriage partners, like-minded individuals interested in just short-term friendships and companions for leisure activities are doing a roaring trade. Speed-dating events, at which attendees have the opportunity to meet and “test” a large number of people in just a short space of time, are popular among singles and are heavily attended.

3.2.3 Home life

3.2.3.1 The living environment divide

The divide between rich and poor is also evident in people's living spaces. Part of society – people with low incomes – live in apartments in rundown, largely empty housing blocks originally built between the 1950s and the 1970s. Others in the lower income bracket prefer so-called low-level housing – inexpensive buildings, easily recycled after a period of occupancy lasting around 50 years, and generally located in less salubrious areas close to, say, transport infrastructure or industrial sites. For the most part, migrants live in plain but functional container developments. Large settlements inhabited by the poor have grown up on the periphery of major cities in Eastern Europe. The housing they occupy often has insufficient sanitation and is inadequately heated because it is largely provisional or consists of old, prefab apartment blocks that have been poorly renovated, if at all.

Wealthier segments of the population mainly occupy high-level housing in which living areas are equipped with networked digital and telematics systems that control a comprehensive array of functions. This high-level housing is located in urban residential parks or complexes with their own security and a concierge service that takes care of the power and technical systems, and organizes everything from childcare to theater tickets. More and more frequently, these premium housing complexes have a common online platform, which not only creates a sense of identity but, by networking the occupants, also helps an essentially virtual neighborhood make the transition to a genuine neighborhood community. Many occupants use their community's virtual shopping mall, which offers a range of products aligned with their needs. Here they can order goods and have them delivered either to the “global point” (a kind of marketplace and services center located in the housing complex) or directly to the home.

3.2.3.2 Born to move

In a society in which life contexts change rapidly, people are relocating much more frequently than before. Changes in people's job situations, financial resources and family environments are common reasons for moving house. As a result, one of the most important criteria considered when purchasing residential property is the ease with which it can be sold subsequently. Many real estate companies (which today are international players) have responded by offering the option of repurchase. At the same time, electronic real estate sales platforms and exchanges have emerged, putting an end to the once widely held perception that a house or apartment is a purchase for life.

The most frequent reason for relocating is a change of job. If school-age children and a life partner with limited flexibility regarding their job situation are part of the equation, an increasing number of families are opting to have two homes: one at the place of work and another at the family's primary place of residence. Situations in which couples are living apart together (LATs) have given rise to several new styles of living. Increasingly, professional people team up to share accommodation for reasons of cost but return to where their families live to spend their leisure time. As convenience has high priority, so-called concierge living, complete with laundry and shopping services, has become commonplace in locales close to employers and in places with a high density of businesses. The number of "hometels" – combined hotels and small offices intended for working nomads – has also risen enormously.

3.2.3.3 Living space functionality

These days, people place a premium on optimally adapted living space designed to suit a particular life phase and number of occupants. This trend has boosted demand for variable partitioning systems that allow walls to be added and removed as necessary to suit occupants' current needs over the short or longer term. Increasingly, houses are built in a modular style centering on a box-type unit containing the kitchen, the media zone and sleeping area, to which

other, smaller modules for, say, sports and hobbies or for children's rooms, can be added. When the time comes for the children to move out, they can either take their living module with them or sell it to a young family.

3.2.3.4 Mobile real estate

The frequent need to move because of job changes has sparked a count-ertrend centering on a strong desire for a permanent base and one's own four walls. The construction industry has responded by developing a mobile, box-type dwelling unit, the smallest prefab house product available. With its small size (it measures, on average, just 4 x 12 meters) it can be installed or readied for removal within the space of a few hours, and can go wherever its occupants wish, more or less at the drop of a hat. This concept has now been embraced on a large scale. At one-third of all new housing developments set up as part of attractive deurbanization programs, frames are erected – instead of new houses – into which these dwelling units can be inserted. An alternative and more costly variant consists of creating foundations for these boxes in attractive surroundings. In a detached setting, these dwellings afford their occupants a sense of wellbeing – comparable with that previously experienced in a single-family house. Closer set buildings, by contrast, are the hallmark of less permanent settlements and neighborhoods. In its more expensive, lifestyle-oriented form, this kind of box can be mounted, say, on the flat roof of an apartment block or a raft moored on a lake or river close to an urban area. In light of this trend, residential property is being divided increasingly into two separate types, namely conventional dwellings and the residential equivalent of storage areas.

Another recent phenomenon and innovation is the virtual address. This has emerged out of people's desire to meet in 3-D space with others with whom they normally only communicate over the Web. There are now numerous purchase and sales platforms for virtual addresses, complete with images and 3-D tours, and some who have not managed to purchase attractive property in real life can at least offset this shortcoming in the virtual world.

3.2.3.5 A life center away from home

Urban apartment dwellers are spending less and less time at home. Living modules or boxes therefore are only equipped with minimalist kitchens that are not partitioned off from the media zone. The reason behind this trend toward spending time away from home is the constant, almost obsessive interest in developing new contacts, be it with potential romantic partners in the case of singles, or purely in an effort to widen one's existing network of friends and acquaintances. Restaurants and cafes have latched on to this development and now offer a so-called third place alongside the work and home environments. The third place is a consumer environment equipped with professional logistics that nevertheless offers a sense of being at home and where people can come and go as they please. The number of business lounges, too, is on the increase, serving as an additional office parallel to the desk at home or as an office substitute that additionally offers an opportunity to rub shoulders with other self-employed and independent professionals.

3.2.3.6 Industrialization of the construction sector

The construction of everything from small residential properties to multistory apartment complexes is undergoing a gradual transition from traditional artisanship to industrial construction because of the increasing degree of prefabrication. Assembly instead of construction is the motto of the day. The benefits consist primarily of affordability, high quality down to the last detail and a dependable cost structure.

In private residential construction, the onset of a trend in favor of "house on demand" systems is in evidence. These systems enable buyers to put together their own house on a computer – with or without the assistance of an architect – rather than buy a home from manufacturers offering ready-made models of houses in a limited number of variants. As a result, the distinction between prefabricated houses and architect-built houses has become increasingly blurred. Processes of concentration involving the construction industry and furniture

manufacturers have taken place, as is evident from two initial ranges of modular homes produced by a major Scandinavian furniture maker and by an Italian manufacturer of designer furniture.

In the case of multistory buildings, the trend toward greater prefabrication is leading to so-called system construction, which aims to make the building process faster and simpler – by incorporating ready-made mounting brackets into walls to ease the installation of windows, for example. This principle has also been applied to other components to create roof systems with built-in solar panels, prefabricated wall segments complete with technical infrastructure and stairwells with elevators. Because the parts are constructed on an industrial scale, many of the people and organizations previously involved in the planning and execution of construction projects have become superfluous. A large number of building contractors now operate as full-service providers, offering clients a single point of contact for the entire duration of the construction project. Although this trend has led to job losses in the construction industry, it has introduced significant advantages, including shorter construction times and better quality assurance.

Greater cost awareness with regard to the construction and running of homes has helped to promote the popularity of low-energy housing to the point that it has become the new standard. It is not uncommon for houses to generate so much energy that they can feed surplus power back into the grid. Multistory, passive-energy houses, too, are at long last capable of meeting consumer expectations, even in the face of greater extremes in climate fluctuation. On the downside though, the energy savings achieved with low-energy and passive-energy houses are effectively eliminated up-front by the construction industry, which has failed to fully embrace the principle of sustainability and neglected to conserve energy in the production of components; at the same time, globalization has actually led to an increase in the distances that construction materials are transported.

3.2.3.7 Transportation

The automobile is the dominant means of transport in cities, not least because it gives people a sense of safety and protection and enables complete mobility.

Advances in the field of telematics have made life easier for motorists. Systems are now in place that warn them of potential dangers and traffic jams and help prevent collisions and pileups. On certain selected stretches of highway, cars can travel automatically, allowing drivers to do other things without having to pay attention to the surrounding traffic – like work at computers, watch television or share a conversation with passengers.

The types of automobiles available are not just as varied as the people who drive them (auto brands are cult brands; they say a lot about their owners' life goals and lifestyles), they also reflect the widely ranging uses of this means of transport. Parallel to running their own automobile, a notable number of people now have a timeshare in a vehicle from one of the major car hire companies so that they can enjoy the benefits of a purpose-built vehicle for, say, a favorite sport, long-distance travel, hot summer days or snowy winter days.

Transport carriers operate frequent high-speed rail and air services between Europe's major cities. These services are viewed merely as a complementary form of transport parallel to road networks, because travelers generally switch to an automobile once again when they arrive at their destination station or airport. Although Europe's rail lines have been separated into dedicated networks for goods and human traffic that allow long trains to operate automatically, the majority of goods are still carried by road, not least on account of the lack of sufficient rail network capacity.

Pneumatic dispatch systems have made something of a comeback in several major cities, where they are used to move small vehicles loaded with europalets of goods along underground tunnels in downtown areas. These systems are reducing the heavy goods traffic and expediting goods deliveries in city centers. This underground cargo system is also inexpensive because, just as with the

road network, the authorities are not passing on the cost of the capital investment to users in full. Narrow in diameter, the underground tunnels can be dug relatively inexpensively, without disrupting road traffic; also, the handling of the goods requires little space because consignments reach their final destinations in office buildings and stores by elevator.

3.2.4 Work

3.2.4.1 The delocalized workplace

Now that mobile computing ensures user access to servers from anywhere in the world, the work environment is becoming increasingly delocalized. Today, a workpoint in an office often consists purely of a document container that can be pushed to a multifunctional desk used by any one of a number of different workers, depending on who happens to be in the office on a given day.

Distinctions between work and leisure time are becoming increasingly blurred. The home is no longer a place where people occasionally complete urgent work after hours or the classic home office of yesteryear, but a regular place of work, alongside the office. Ubiquitous working is also commonplace, with many people now working on the fly, using lounge areas in malls, train stations and airports and even their own cars as an “out-of-office office.”

The dictates of global business have led to a situation in which employees are often sent to work in other countries for the duration of specific project work. These work nomads regard travel and working in different locations around the world as nothing out of the ordinary. In contrast to previous practice, however, they are not paid any additional weighting that would normally enable them to enjoy an exceptionally high living standard while abroad.

3.2.4.2 Employee networks

In a parallel course of development to workplace delocalization, work teams are now created on a project by project basis, effectively changing how companies are organized. It is now rare that all team members work at the same location; as a rule, they tend to be spread all over the world, only meeting face to face occasionally and dealing with the majority of their tasks using electronic means of communication. In addition, these temporary teams, formed purely for the purpose of solving a specific task, are disbanded again on completion of the project and their members assigned to new tasks in other constellations.

However, many members of these ad hoc teams remain networked with former colleagues, so they constitute a powerful informal group that can exert an influence on companies if necessary. At the same time, the ability to leverage networks of contacts to further company objectives is an important qualification criteria today. Employees who understand how to make these networks work for their companies are both entrepreneurs and key communicators at once. They drive interpersonal and professional communication, both within their own business unit and between business units, and are often in a position to circumvent established organizational structures and communication paths as a result. Frequently, they represent the real value of the company. They are the ones who keep the worldwide network of people and ideas alive and who make sure that the right teams are given the right ideas to run with.

To encourage efficient working, work rooms and team rooms are equipped with electronic walls and tables to which users can hook up personal computers. Team efficiency has increased substantially because meetings are prepared thoroughly up front and the minutes are completed while the meeting progresses. However, this also makes for a more pressured environment and places considerable demands on attendees.

3.2.4.3 Employee loyalty and employability

The relationship between employees and employers is much more flexible than it was 20 years ago. Employees no longer feel tied to their employers as such, but expect to be courted actively by the company they work for.

To secure the loyalty of high-achieving employees, companies enable them to share in the profits. Alongside these high potentials, who are part of the core workforce, companies have an ancillary workforce consisting of permalancers, freelancers and older, former employees, who, with their experience, serve as a backup workforce and are kept on standby for particular tasks. The status of individual employees within these distinct groupings can change frequently and on short notice; however, a change of status is not equated with being fired in the conventional sense (in which case the employee in question leaves the company permanently). People work in teams whose members change at intervals, who come from a variety of cultural backgrounds and whose contractual relationships with the company differ and can change frequently.

One aspect of this trend is that individuals may actually work for, or have an employee-like relationship with more than one company. Modern employees market their professional capabilities to potential employers. At the same time, companies are extremely interested in protecting their employees' employability so as to ensure that their people can quickly find other work if there is a sudden need to shed HR capacity.

Since employees have become responsible for marketing themselves, the increase in the number of people working in multiple jobs has blurred the distinctions between self-employment and regular employment. There are also signs of a return to a barter economy. The rapidly growing ranks of permalancers and freelancers support one another by sharing their knowledge and skills through networks of former job contacts. In instances where individuals are unable to afford to pay for support, remuneration often takes the form of unpaid assistance and services on a quid pro quo basis.

3.2.4.4 Business competition

Competition between companies is tough and price pressure is high. In part, this is due to the constantly accelerating rate of change in markets. Because consumers' tastes shift quickly and consumers are highly innovation-conscious, product life cycles are getting shorter all the time. In addition, consumers enjoy a very strong position because the majority of today's markets are buyers' markets.

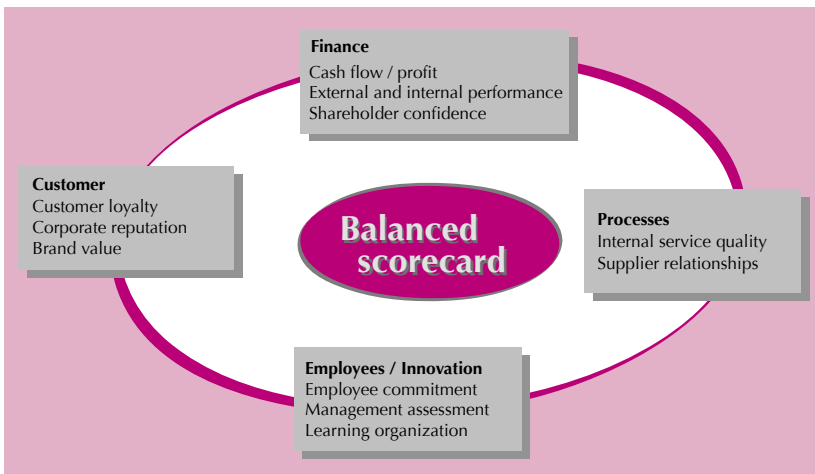
In the B2B sector in particular, buyers generally think in terms of the total cost of ownership across the whole of a product's life cycle – including the expense of consumables, spare parts, servicing and maintenance – as well as the product's anticipated useful life. Consumers, too, are paying greater attention to life cycle costs: When purchasing a printer, for example, they take into account how much they could end up spending on ink or special paper. This has effectively put an end to the old strategy of offering products as cheaply as possible and generating profits from the sale of consumables.

Businesses are trying to escape the rigors of this tough competitive environment and its instant comparability of products, services and prices by creating and promoting unique selling propositions. They do this by concentrating on their core strengths: A highly motivated workforce, strong customer relationships and the ability to build and maintain powerful brands, for example, are all key success factors.

The need to develop unique selling propositions, the high pressure to innovate and short product life cycles all call for readily available capital, with the result that companies are more dependent on financial markets than in the past. The financial markets want fast and exact information – not just on profits and earnings growth, but on companies' overall situations, too, and their primary focus is on shareholder value. Accordingly, companies are working to an extremely short timescale, and strategic control tasks are widening in scope.

3.2.4.5 The balanced scorecard

In today's competitive environment, in which speed, rock-solid decision-making and a willingness to engage in risk are the critical factors that determine success or failure, it is important for businesses to extend their strategic internal control mechanisms to include continuous monitoring of key financials. One tried and tested method is the balanced scorecard, which tracks financials and other key figures that reflect customer loyalty, process quality, employee loyalty and innovative strength.



This instrument enables companies to identify potential derailments in advance and to take fine-tuned, appropriate and – as far as is possible in a world changing this rapidly – sustainable corrective action.

3.2.4.6 Brand management

Another key success factor is brand management – the process of creating product brands and growing them into cult brands that embody a particular spirit or attitude. Today's accounting principles governing the preparation of corporate balance sheets allow brand equity to be reported as an asset item. Some companies do nothing but represent and promote their brand, leaving the responsibility for manufacturing and sales to networks of partners. This approach is leading to the emergence of meta brands that unite otherwise disparate fields such as fashion and travel. These days, strong and successful brands are presented in sophisticated showrooms and consulting areas set up solely with the purpose of brand promotion. In some cases, these smart, up-market facilities are entirely divorced from any form of selling so as to further heighten the cult surrounding a particular brand and to avoid disadvantaging local retailers.

3.2.4.7 New markets

Large, rapidly growing markets have emerged in such areas as education, health care, security, logistics and mobility. All of these markets are not just dependent on capital in order to be able to deploy the latest technologies; they are also creating plenty of new jobs because they are highly human-resource intensive. Thus, joblessness is a thing of the past, and because the new jobs being created are essentially “high-touch” in character and serve purely local markets, they cannot be exported to other countries.

Services aimed at private households, too, are a steadily growing market. Lower social security costs and a reduction in the tax burden on people in low-paid work have caused the demand for services in private households to surge rapidly. Home organizers and party drifters (people who organize private parties) now offer their services alongside people like life coaches and information brokers who help private individuals to manage more effectively the flood of information to which they are subjected daily and who prepare strategies tailored

to individuals' information and communication needs. Also, many families can again afford to hire household help to live in with the family and take care of the children. These various services are offered by specialist companies as well as by private individuals.

3.2.4.8 Company networks

The rapid pace of change in markets and companies' high dependence on financial markets is introducing profound changes in the business and corporate landscape. Companies are formed, then grow, enter into alliances, and often, as soon as they show up on the radar as potential competitors, are taken over by larger companies. To increase the return on capital, they are sometimes broken up into a number of separate units dedicated to handling specific tasks or servicing specific regions. This cycle of mergers and demergers is being superseded to an increasing degree by a trend in favor of forming company networks, a new strategy designed to make businesses more nimble and responsive. This strategy also amplifies synergy benefits without incurring the high costs typically associated with integrating different corporate cultures and management structures. In cases where such alliances fail to deliver, they can be disbanded again as quickly as they were formed. The increasing delocalization of work and the general mindset among employees (described earlier) are adding momentum to this trend.

The new buzzword is “networked learning,” a term describing a situation in which multiple organizations, united within a common network, learn together. This multi-organizational learning today complements organizational learning and the lifelong learning engaged in by individuals. Networked communicators, described above, play a critical role in this learning process.

3.2.5 Consumption

3.2.5.1 Polarization between discount and luxury goods

Reflecting the disparity in income levels across the population, a dual market has emerged which, at its lower end, offers inexpensive products with an identifiable “net value” for less well-off segments of the consumer base. These products are sold primarily in discount markets on greenfield sites and in discount department stores with rummage tables, unsorted goods by the pallet load and reduced-price factory rejects. By contrast, higher-earning consumers focus as a matter of course on products with clear functional benefits and added value in the form of the promise of a particular lifestyle, social standing or making them exceptional. To emphasize this added value, businesses are creating increasingly complex and sophisticated stories and imagery to establish contexts in which consumers can experience their products. These products are sold primarily in smart downtown boutiques and in upscale department stores and shopping malls.

Products in the zone between the bargain basement and lifestyle ends of the spectrum have disappeared almost entirely, as manufacturers and retail chains specializing in the medium-price segment have either refocused on the lower end of the market or have gone out of business.

3.2.5.2 Consumption as a symptom of yearning

Besides purchasing essentials to cover daily needs, consumers also buy things out of a sense of yearning – products and services which, in a society largely obsessed with appearances and an aspiration to perfection, offer the promise of attainable ideals to people in situations where they feel dissatisfied or a sense of inadequacy. This is the only reason why “forever young,” “always fit” and “best beauty” products sell like hotcakes in an essentially enlightened society.

Consumption also exhibits a yearning component in situations where the act of purchasing itself offers consumers a certain added value (e.g., relaxation or education) and the actual utility of the product takes a back seat. Possession

is equated directly with being. Those who seek to acquire greater charisma for themselves purchase self-help books, skim through them and, as a result, feel a considerable step closer to fulfilling a particular wish.

A third variant in this area of consumption revolves around satisfying the need for a multi-optional lifestyle in which, in theory at least, anything is possible, anytime. In an effort to be as flexible as possible, people prepare for all kinds of eventualities. Among “consumists” hungry for experience, this expresses itself in the purchase of, say, multiple sets of skiing equipment so as to be ready for snow of any kind. And for vendors, this means immense brand and product diversification. The more demanding the dictates of working life, the more people seek to fill and optimize their increasingly limited free time with a growing assortment of activities. However, the expanding diversity of products and brands is causing palpable stress among consumers overwrought by the rigors of making purchase decisions. Often they feel compelled to hire the advice and services of independent “professional shoppers” to ease the process. But when it comes to the stress of choosing from the vast number of different ways to spend their free time, consumers are still left to their own devices.

3.2.5.3 Brands as a means of self-realization

In light of society's fundamentally materialistic and individualistic mindset and the attendant lack of meaning or collective orientation, people are seeking to fill an inner void by turning to brands as a source of significance and guidance. Thus, they use brands as a means of endowing themselves with desirable attributes – athleticism, for example, by wearing a certain brand of sports shoe that automatically associates them with a particular social caste or grouping. Here, brands serve as auxiliary personalities and as a surface on which to project specific traits or attributes broadly accepted as significant or relevant. People prefer to showcase rather than develop their personalities, because brands, through their ability to bestow desired virtues easily and on an ad hoc basis, eliminate the need to work on one's self.

Scenario 2 – Life in the year 2020 – Consumption

In addition, brands are playing an increasingly important role in communication in that they document personality traits on the outside – a case of “Show me your brands, and I’ll show you how you are.” Brands serve to signal a global, independent and cosmopolitan lifestyle to the world around – for example, as one sits sipping a latte in a trendy coffee bar. More and more, lifestyles that carry a demonstrative force through chosen brands are displacing traditional social ties.

Many consumers now also use particular brands selectively to underscore their mood of the moment or achieve a certain effect – say, the creative professional in the morning and the life-hungry adventurer in the afternoon. For vendors, segmentation by target groups has long since lost all relevance because of society’s highly fragmented and individualistic nature. As a result, manufacturers are attempting to deliver contexts in which their brands can promote certain images or ideas – for example, that consuming a specific type of mineral water can help one to work productively and effectively, or that drinking a brand of beer that represents a spirit of change can help satisfy one’s hunger for life.

3.2.5.4 Easing the burden of buying daily necessities

The effort involved in the day-to-day purchase of food and other necessities has been minimized for consumers through extensive collaboration between software makers, chip manufacturers and the consumer industry with the goal of improving the point-of-sale experience. In spite of initial critical debate, every product is now equipped with a radio frequency identification (RFID) chip. The advantage is that this radically reduces waits at checkouts, because all consumers need to do is pass the goods over a scanner installed in the shopping cart, push a button marked Pay at the checkout, and have the necessary amount of money at the ready. Once at home, the built-in chips are passed over a scanner mounted on the fridge, allowing the fridge to keep track of items that are running low and display an electronic grocery list. The RFID chips also offer major advantages to retailers because they allow inventory management personnel to check stock levels on shelves at any time and to adjust their inventory management accordingly.

Electronic “shopping advisers” with interactive screens built into shopping carts notify consumers about special offers, direct them to the aisle or bay in which the desired product is located, suggest recipes for cooking the product in question and provide information on the product’s origin or manufacture. Smart carts use cameras and software to identify the fruit or vegetables placed in them. The price labels on shelves are liquid crystal displays that can be updated wirelessly, and purchases can be paid for using e-payment or m-payment systems.

Consumers in higher income brackets are delegating grocery shopping more and more frequently to the concierge service in their apartment complex or are using retailers’ own electronic or phone-based shopping services. The goods they purchase are then either deposited in storage boxes secured with special access codes (now a standard item at one in two apartments or houses) or delivered straight to the home.

3.2.5.5 Experiential shopping

In contrast to daily necessities, lifestyle products are sold in an experience-centric way. When people shop for these products, the reason for the purchase itself is no longer relevant, the actual shopping experience is what counts. To a degree at least, shopping is thus about inducing a distinct “state of being” in which products, services, and salespeople are merely a medium for delivering a particular inward experience to be enjoyed in a space created solely for that purpose. Stores designed specifically to present the product, complete with terminals that recount the product’s history or props and accessories that allow consumers to experience the product up close, seek to offer an immersive product and brand experience. Multimodal presentation heightens this effect. Integrated lounge areas, cafes or libraries – that people are free to frequent at their leisure, under no pressure to make a purchase – encourage consumers to spend longer on the premises and enjoy a more enduring shopping experience.

Stores selling specific brands become meeting points for like-minded people, and shopping for lifestyle products has become one of the most popular leisure activities. A product’s lifestyle value (as opposed to its monetary value), namely

the perceived emotional dimension that it adds to a person's quality of life, is what counts. However, the number of "spendaholics" is on the rise – people whose purchasing pleasure exceeds their purchasing power and who, as a result, are forced to enlist the support of an expanding body of debt counselors. People with just a low disposable income are more or less excluded from this world or, at best, play the role of spectators at free events in shopping malls. It is only thanks to the security services on guard everywhere that crime by people from low-income social strata – above all, youngsters driven by the desire to own branded goods – can be kept under control.

3.2.5.6 From products to full-service offerings

Manufacturers and retailers have to go to considerable lengths to curry favor with permanently stressed consumers. Among the wealthier in society, time is gradually becoming an even harder currency than money. Accordingly, products have to deliver on a promise of optimum time efficiency and, by extension, absolutely trouble-free use. This means that even the most minor functional shortcoming can trigger an instantaneous switch in a customer's manufacturer preference. In addition, products' ease-of-use is taken for granted and is accorded high importance in the product design and manufacturing process. With products that require user instruction, a number of manufacturers and retailers now send out technicians to familiarize consumers with the equipment and assist with configuration. After-sales service is a crucial customer loyalty factor. Customers can choose from a wide variety of after-market services – everything from integrated chips that indicate when a product needs repair to the automatic delivery of updates and system upgrades on-site when new technology becomes available – provided they are willing to pay the price.

3.2.5.7 The new world of electronic shopping

In the B2C sector, e-commerce has advanced to become an accepted procurement channel parallel to bricks-and-mortar retail outlets. The Web is no longer used to sell just homogeneous product ranges, such as books or CDs, but a complete and comprehensive range of lifestyle products. Electronic shopping's main advantages are the complete freedom consumers have to browse product

offerings in their own time, the medium's ability to provide information tailored exactly to consumers' needs and the high price transparency afforded by so-called e-butlers (digital agents that scour the Web for the best offers available). To make electronic shopping a more engaging experience, online malls and stores sport highly sophisticated designs, complete with 3-D visuals. The majority of conventional stores and shopping malls also maintain a presence on the Internet through which they offer their goods for sale electronically. Here, buyers are able to shop in a familiar environment and receive the desired products rapidly. Manufacturers often operate shopping tours on the Internet, styled on thriller movies or fantasy adventures. E-models configured to match one's own proportions can be dressed in particular clothing and then viewed in a variety of settings – at work, at a party or during some form of leisure activity, for instance – to test a particular look. The stationary retail and e-commerce sectors coexist in a complementary relationship, with the first offering a specific service in the form of sales consultations for products requiring explanation, plus repair services provided in association with manufacturers.

Direct contact between consumers and manufacturers through e-commerce enables consumers to put together the products they want from a wide variety of available options. With shoes, for instance, they can choose from a range of colors, styles and heel designs. As a result, consumers increasingly are becoming prosumers (producers and consumers), helping to design or customize the products they purchase. They are able to influence the manufacturing process by notifying manufacturers of their wishes for changes, and the products can be altered accordingly. Due to the low logistics costs associated with on-demand offerings on the Web, niche market products with low unit sales can be marketed to small target groups.

3.2.6 Travel

3.2.6.1 Artificial vacation worlds

Wealthy tourists' vacation expectations – typically, the perfect mix of comfortable surroundings, foreign flair and physical exercise in moderation – have risen considerably. To meet these expectations, the travel and tourism industry has begun creating staged and orchestrated vacation worlds, albeit at the expense of originality, authenticity and reality. The desire for the perfect and consummate vacation in a society less and less tied to specific locations is evident from the creation of artificial vacation environments in which luxury resorts and apartments – everything from Tuscan-style country villas to faux ranches – are erected on artificial islands in the ocean, complete with seemingly endless, pristine sandy beaches. New mega cruise liners with capacity for up to 10,000 passengers offer another form of complete and perfect vacation world. For anyone tiring of the permanent sea view, these ships offer an equivalent breadth and depth of entertainment, shopping and recreation offerings as a small city, plus water sports in the ship's own yacht harbor. This trend in favor of the artificial is also apparent in the designs of giant theme hotels, facilities with around 10,000 rooms, like the Moon over Vegas, where guests come to escape the natural daylight and spend their visit in the eternal twilight of outer space, with a view of an artificial lunar landscape and space rockets.

3.2.6.2 Premium vacations

In the wake of the package tourism of decades past, the world is now regarded as having been thoroughly explored, and no-one can find cachet any longer by seeking out remote regions and places. Consequently, people are seeking new factors through which they can set themselves apart. Their options include using up-market means of transport like premium-class cruise ships, historical steamers, or retro rail trains, or visiting exclusive vacation enclaves frequented by the rich and famous. Tour operators have responded by adapting their sales channels to this clientele. Instead of old-style travel agents' offices with plain and functional interiors, they are setting up travel centers decorated in a range

of styles typical for a particular country, complete with authentic aromas and indigenous snacks, where travelers can sample the ambience up front. Well-trained travel assistants identify their clients' wishes and interests so as to make vacation suggestions that fit the bill. Video displays and Internet terminals are on hand to provide additional information, and clients can browse travel guides at their leisure in quiet zones. Vacation-related services, such as on-site security, grocery deliveries timed to ensure that the fridge is restocked on the day of return, accommodation of family pets in animal hotels or the procurement of medical supplies prior to departure, are also available.

3.2.6.3 Addiction to adventure vacations

For many, their own experiences with vacations and the increasing coverage given to exotic countries in the media mean that travel has ceased to be something exceptional or out of the ordinary in comparison with day-to-day life. For tour operators, this means digging deeper and deeper into their bags of tricks to introduce new elements of adventure and excitement to vacations. This trend has led to an upgrowth in so-called mystery travel offerings in which just the country of destination and the route are known in advance and the journey is spiced with staged, unexpected situations that people need to overcome either individually or in small groups – sudden disorientation in the jungle, a night spent under the stars or a breakdown in the middle of a long road trip, for example. The focus here is on mixing games with reality. Another variant that promises to add zest to vacations and make them exceptional is to put people in extreme settings. Offerings here include stays at base camps of “eight-thousanders” and at research facilities in extreme regions. Ordinary vacations, too, are jazzed up with off-the-peg adventures like hand-feeding sharks in 30 meters of water, or going on self-supported jungle treks led by local guides.

3.2.6.4 The multifunctional vacation

As people have less and less free time at their disposal, they expect vacations to meet a number of different needs at once. These typically include opportunities to engage in sports, to relax, and to soak up exotic local flair. To meet this requirements profile, operators are combining foreign travel and wellness

programs with a brief concluding sightseeing tour and shopping spree. Tour operators now offer comprehensive programs compiled from a range of different “modules,” which, because they create the impression of having been hand-picked for the client, look like a premium offering at first glance, whereas in fact they are designed to address the needs of a much larger target group. In Europe, city tours are often combined with wellness programs. Specialty wellness and fitness hotels in major European cities offer guests a personal adviser to help them maximize physical recuperation in a program rounded out by gourmet meals and shopping trips.

3.2.6.5 Global hopping

The popularity of long-distance vacation travel has increased steadily through to the present day, not least on account of globalization. As businesses have become more international, their workforces more mobile and large virtual communities have developed, people’s circles of friends have become much more global in scope. For many young people, a trip round the world lasting several months is now the norm as a vehicle for personal growth and as a rite of passage marking the transition into adult life; on journeys like this, they typically make a large number of friends in foreign countries. In addition, global clubbing in international cities and vacation resorts is very much in vogue among this generation. The amount of time spent at any given location is shrinking though, because the desire for constant change has led to a change in travel behaviors, with people now tending to hop between an increasing number of locations during the course of a journey.

3.2.6.6 Growth in business travel

Although virtual teams, videoconferencing, and augmented reality are all part and parcel of today’s business world, high-tech means of communication are still no substitute for the high-touch factor of a personal encounter or the chance to experience new markets up close. As businesses, research organizations and interest groups continue to globalize, business travel is actually on the increase. Business trips also continue to play an important role among high achievers as a status factor and a performance incentive.

3.2.6.7 Education on vacation

Now that people change employers more frequently than in the past and lifelong learning has acquired such importance, more and more time on vacation is being devoted to continuing education and training. Education providers and tour operators have successfully tapped into this new high-growth market. Much of the training that people choose to take centers on languages and soft skills (e.g., management, social competency, etc.) that are useful in business. The courses are offered at locations with a vacation-type character to enable people to recuperate at the same time. Another sector that has formed in this market is business study tourism, in which people visit best-practice companies or projects that are models of, say, advanced manufacturing or exceptional customer service. In this case, operators not only do the background research, they also organize a travel guide. A third variant consists of summer courses at selected universities or business schools in combination with cultural and sightseeing programs.

3.2.6.8 Budget vacations

Due to the extreme divide in wealth across the population, people with a low or irregular income are unable to afford costly vacations. As a result, vacation at home and all-inclusive offerings, primarily within Europe but also further afield, are in high demand because the expense is predictable. Operators are able to keep prices down by using vacation facilities formerly patronized by a clientele in higher income brackets but now fully amortized and maintained to just simple standards. In addition, minimalist vacation variants in the McTravel style are offered to the low-price segment – cruises and city tours featuring simple food and accommodation, and without any special program, for instance. The price advantage in the warmer regions of Eastern Europe also appeals to the same target group, and the vacation resorts on the Black Sea have become proletized as a result. The preferred sales channels for cheap vacation travel are discount markets of all kinds and the Internet.

3.2.7 Leisure

3.2.7.1 The leisure divide

The way people spend their leisure time depends heavily on their income. Those with low earnings and irregular sources of income can only engage in free activities during their spare time, which means an increased focus on passive media consumption (e.g., television). Those who attain a high level of income by mastering an extremely challenging job only have a limited amount of time and attention that they can devote to anything outside work. As a result, the leisure industry has to think up engaging and compelling offerings in order to reach this particular target group.

3.2.7.2 Dramatized leisure

As work and leisure time intermingle to a greater degree and work requirements become more rigorous, people seek to derive a maximum in terms of valuable experiences in as short a time as possible. Activities like shopping, skiing or dining out need to be charged up with extras to make them an exceptional experience capable of satisfying people's growing desire to make the most of life. This is achieved by combining different offerings in one place: Shopping malls, for example, are becoming a theme park-like experience, complete with climbing walls, half-pipes and even live rock music. Rather than simply eating out, people now favor theme dining: Restaurants stage "mystery dinners" that create a thriller-like atmosphere in which the meal becomes a mix of spectatorship and participation.

Staged or dramatized elements are also creeping into leisure sports to introduce an additional kick. Examples include pop concerts in ski arenas and adventurous ways of experiencing nature, such as canyoning and speedboating. Another variant when it comes to searching for special experiences in day-to-day life is the continued trend toward real-life role-playing in the context of social encounters. Rather than seeking a simple social exchange to share news and ideas, people now try to get to know themselves from a new side under the guidance

of a professional game supervisor. In these role-playing games, the only given is the general theme – a horror story or love story, for example – making surprises and challenging situations inevitable in an essentially “all against one” atmosphere.

3.2.7.3 Self-promotion in the media

More and more, the pressures of the daily work environment are giving people the sense that they are living in the slow lane and that they are commonly regarded as nothing more than a resource performing a particular function. People’s yearning to live out the whole of their personality and to stand out in the crowd is becoming all the more pronounced as a result. One avenue they choose is to recount intimate details of their private life in front of a large audience of strangers. In this context, the Internet has advanced to become an important medium of self-promotion – be it by posting a digital photo album of snaps taken during a recent Caribbean vacation or eagerly publishing details of one’s strong points and weaknesses in an i-blog. In their free time, people live constantly as if they were the subject of a live TV broadcast, with a camera at every turn.

This feeling is heightened by a growing camera presence in public. In discotheques, theaters and shopping malls, people find themselves “in shot” with increasing frequency (by chance or otherwise), and by watching themselves in these videos, they gain a stronger sense of their own identity. Disco and theater foyers too often have video hookups to their counterparts in other cities, enabling, say, audience members at an opera premiere at La Scala to raise their glasses during the intermission to unknown faces in the Met. Phenomena like people’s increasing desire to participate in TV shows in order to display what they perceive as their unique and special talents or the immense demand for the chance to take part in reality TV shows reflect a powerful hunger for significance and celebrity. The demand is such that it has spawned a minor industry of casting agencies and performance coaches.

3.2.7.4 Achievement-focused leisure

In an environment in which work, for a large number of people, is nothing more than a means of earning a living and today's successes are forgotten in an instant, many are "making a career" of pursuing leisure activities in a search for meaning and success. This partly explains the immense interest in types of sports with a strongly competitive angle and the need for immense stamina – marathon running and bi-/triathlon, for example. Sports with complex qualification systems, such as scuba diving and martial arts, also help people to experience success milestone by milestone and offer a chance at least to ascend a hierarchy based on merit during their spare time if not at work. Expedition-like undertakings, including mountaineering at altitudes above 3,000 meters, crossing inhospitable landscapes, and going on jungle treks make people temporary heroes within their personal sphere, particularly if they can later relive the high points at home on DVD. Even personality-building programs designed to help people to find themselves incorporate an achievement-centric aspect in the form of grading systems or through the assignment of challenging tasks like spending several days alone in the wild with just rudimentary equipment.

3.2.7.5 Recuperation-focused leisure

Due to the limited distinction between work and leisure time, recreation and recuperation activities have to be passive, functional and fast-acting. To meet this need, there are now bars in public places where people can drop in to fill up on vitamins and oxygen. There are also relaxation zones in shopping malls, train stations, and airports, where people can hook up to machines that instantly put the brain into a relaxed yet active state. Other options they can choose include massages, cosmetic care and even absolute sensory deprivation in a saline tank. Wellness is now a product consumed without any active participation by the individual. The emphasis on active wellness tends to be much lower, because gentle sports and meditation in today's fast-paced life take too long to deliver the desired benefits.

3.2.7.6 Social leisure activities

Engaging in leisure activities with friends and acquaintances is becoming increasingly difficult, because around half of the working population keep highly individual working hours. Due to the frequency with which people work in multiple jobs, the project-centric approach to work and the large amount of working time spent dealing with a constant, 24-hour stream of incoming information, people find their free time overlaps far less than used to be the case when everyone had time off on weekends and public holidays.

For romantic partners, the fact that both work makes finding free time to enjoy together even more problematic. This issue has led to higher earners making greater use of household and childcare services. The advantage, though, is that people tend to devote free time more consciously to partners, and their children become their favorite hobby.

Among young people and singles on the hunt for partners, leisure time is confined to a narrow window within a 24-hour span. After-work parties after midnight or Sunday shopping trips have therefore become a common choice of activity. In addition, cafés and lounges – third places – offer this particular social group an attractive option for social intercourse outside of work.

Another important leisure activity is e-clanning or e-networking on the Internet. However, in an “always on” generation for whom the network constitutes an important status factor, there are also so-called disconnected people who spend their time reading books, listening to music or watching movies. They include people with limited Internet access and, above all, those with an introverted disposition.

Massive multiplayer online games, once a niche product but now a mass market item, have also become a modern way to spend time. Movie studios and software makers now collaborate closely on the production of these games, because for almost every epic tale of heroism to grace the silver screen there is an online role-playing game to go with it. Millions of players spend immense sums

of money on subscriptions that enable them to play their favorite games in real time with thousands of other players dotted all over the globe. One downside to this culture, though, is players' increasing psychological dependence on the games and the real world's declining relevance in their perception.

Constant exposure to the new media and the unending stream of obtrusive audio and visual stimuli are giving rise to a need among many for a limited time out. The first time-out zones have now been set up in cities, facilities where people can rent one-person quiet rooms with low-key interiors and a complete absence of all media and means of communication. Clients using these rooms are required to surrender their cell phones when they check their coats.

3.2.7.7 Culturetainment

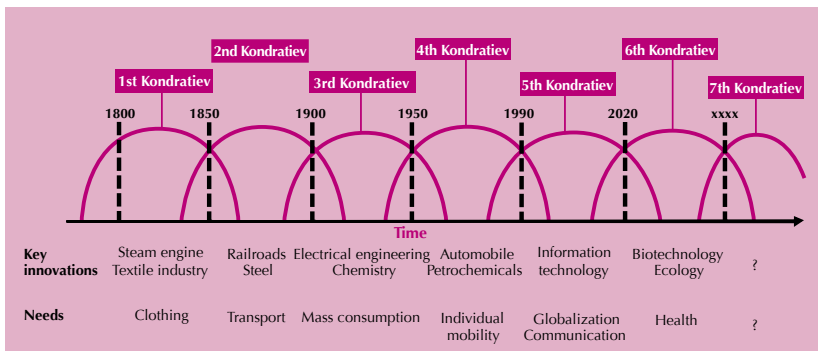
Cities have become hotbeds of culture, with extravagant concert productions, art exhibitions and festivals. Numerous museums and exhibition halls have now been remodeled with a focus on delivering a richer overall experience, while less exciting places like zoos and swimming pools are taking on a new dimension through nighttime safaris and beach parties. The considerable competition that has grown up as a result between individual cultural offerings has led to a decline in classic theater. Even in Europe's major cities, just a few theaters have managed to survive – and only by putting on mainstream shows and pieces that are guaranteed crowd pleasers. Depleted public coffers mean that cultural events and activities are largely funded by private companies and patrons, who use these as an additional advertising platform. This has become such common practice that certain productions (Ballet Week, for example) are now firmly associated with a specific sponsor. However, only people in upper income brackets can generally afford the high ticket prices.

3.2.8 Health

3.2.8.1 Economic development of the health care sector

Thanks to synergies between information technology, genetic engineering, molecular biology and pharmacology, the health care sector now has at its disposal far more sophisticated technology for diagnostics and therapy. Today's society, with its emphasis on achievement, now regards health as the number one asset, and people are willing to spend heavily on it. As a result, health care has become one of most powerful engines driving the economy. The age of information technology (the fifth Kondratiev Cycle), which began in 1970s, has been superseded in the past five to ten years by an age in which health is the key focus (the sixth Kondratiev Cycle).

Kondratiev Cycles



3.2.3.2 A functional perception of health

First and foremost, health is perceived as being about successfully maintaining or raising mental and physical performance through to an advanced age in a rapidly changing environment. One key health guarantee therefore is physical fitness, something to which people devote a large amount of time. Wellness is still in vogue today, but is largely viewed as a means of well-earned relaxation after a successfully completed program of exercise, or tends to be enjoyed in a passive form as a quick way to charge up one's batteries during the rush of everyday life.

The widespread “faster, higher, further” mentality is also leading to a growing sense of vulnerability and thus to a desire to look after one's self well. This need for self-care is satisfied to an increasing degree among a wealthy clientele through the consumption of medical services. Related offerings, including cosmetic care, massage, life coaching, nutrition counseling and alternative medical therapies are also consumed as a means of compensation or self-reward. Certain sports and other activities that promise inner peace are currently enjoying a resurgence in popularity but tend to be dropped again quickly, because many people are unwilling to go to the effort of training regularly or working on their own attitude and decide to blame these activities for not producing the desired results quickly enough.

3.2.8.3 Vanity health care

In addition, health is regarded as a form of capital that requires investment on a regular basis so as to diminish the risk of a drop in value. As age is generally associated with a decline in physical attractiveness and performance, hormonal therapy and cosmetic surgery are far more common than before and have led to a fusion between health care and anti-ageing measures. Plastic surgery is now no longer regarded as anything untoward, and people's bodies increasingly resemble construction sites. The cosmetics industry, too, has leapt onto the bandwagon to join the ranks of those offering medical (re)construction of people's

outward appearance and now markets an expanding range of cosmeceuticals – cosmetics with pharmaceutical properties – designed to offset the ageing process and treat minor blemishes.

3.2.8.4 The medical divide

Mandatory basic medical insurance now only covers essential treatment. Private health insurers have become an established part of the health care landscape, and many are now multinational operations, with clients throughout Europe's economic heartland. Due to the sizeable insurance premiums and the high excess coverage that people are often required to pay in order to receive certain forms of treatment, not everyone has access to a full range of services. In a two-class system, wealthy patients receive preferential care at exclusive clinics or at centers of excellence staffed by a range of specialists, whereas the irksome, less well-off patients tend to be treated in centers offering just standard services where they are processed as rapidly as possible. This has led to a rise in health care tourism by patients, particularly to countries in Eastern Europe.

Expert systems are used to determine patients' entitlement to treatment and the amount of excess they are required to pay. These systems weigh the diagnosis against cost/benefit considerations for every course of treatment. With elderly patients in particular, this can lead to ethical problems, because they may be refused procedures like bypass operations or organ transplants that could extend their lives by a number of months if they are not in a position to pay for these themselves.

3.2.8.5 Self-responsibility for health

To ensure transparency and give patients a means of comparing different offerings, every kind of medical service and procedure has been defined as a product with a fixed set of features. Health insurers only include those products in their service catalogues that have been shown scientifically to be effective and thus to meet the criteria of quality and cost efficiency. The insurance companies maintain statistical records to track the success of each method of treatment and the performance of those delivering it. This information is now supplied to patients,

Scenario 2 – Life in the year 2020 – Health

a crucial advance that has led to a much greater sense of responsibility among people for their own care and the medical services they wish to receive.

Patients also draw on more “objective” and often more “patient friendly” information available on the Internet to complement the information supplied by health insurers. Health care portal sites publish comprehensive and easily comprehensible information on all kinds of diseases and the therapies used to treat them, as well as links to communities of patients with the same problems and to research organizations’ sites.

The fact that medical professionals have lost much of their once considerable information advantage has brought about a major shift in the formerly unequal relationship between doctor and patient, with the former now taking the role of service provider and the latter now in the role of client. This relationship is marked by high expectations as regards the efficiency and the success of treatment. Official ratings of doctors and hospitals prepared by health insurers, unofficial ratings on the Internet and the results of comparative treatment tests have become a valuable decision-support resource that patients now draw on regularly.

The immense degree to which patients are informed means they can now conduct their own routine examinations. They monitor key health parameters daily using biosensors now fitted as standard to household furnishings and fixtures. Checks on other health parameters are conducted less frequently with the aid of biosensors embedded in patches or with labs on chips, which can be bought anywhere. At health kiosks in shopping malls, people can stop by for a quick check-up and a brief consultation for a small fee. Health care is such a pervasive, high-profile issue that there has been an enormous increase in special-interest magazines, newspaper column space and TV shows devoted to the subject. Business is brisk for life coaches specializing in helping people to maintain and improve their health. In shopping malls and elsewhere, people can briefly recharge their batteries for a fee at so-called health stops – cabins in the shape of the old phone booths – which play meditative music, dispense aromatherapy scents and suggest exercises that can be carried out between bouts of work. At

wellness islands, people also pay to be put into an instant state of active relaxation by means of color stimulation or by being connected to a machine that stimulates the brain's alpha waves.

3.2.8.6 From hospitals to health care conglomerates

The first hospital mergers, which happened around the turn of the millennium as a reaction to the increasingly fragmented health care landscape, were the precursors of much larger hospital mergers that have now taken place throughout Europe, creating major health care conglomerates. This strategy of amalgamation was seen as a promising means of achieving new economies in the cost-intensive hospital care sector and exploiting a range of potential location advantages specific to competencies and costs. Patients who are unable to afford costly forms of treatment in Europe's economic heartland can receive the care they need in Eastern Europe, because facilities there subscribe to the same group-wide quality standards, but commonly charge lower rates.

Another advantage of the health care conglomerates lies in the breadth of their offerings. Corporations specializing in orthopedics, for example, operate everything from hotel-like wellness facilities where they offer preventive care seminars to diagnostic centers, emergency treatment centers and rehabilitation centers. This integrated approach, plus the availability of comprehensive electronic patient records that ensure health care personnel have access to all key diagnostic information, have made it possible to coordinate care effectively and to cut costs. Carefully orchestrated communications initiatives are helping to promote these health care corporations and the outpatient health care and research centers with which they work as brands.

3.2.8.7 Pharmaceutical companies and hospital ownership

Many hospitals now operate as business units of pharmaceutical companies. The first step in this direction came when Zeneca acquired oncology centers at U.S. hospitals shortly before the new millennium. This move drew large-scale criticism at the time because of the implied conflict of interests. Today, less well-off patients in particular have come to appreciate this change, because it enables

them to receive the latest methods of treatment at affordable prices. And when it comes to serious illness, patients in every income bracket believe that they can benefit from personalized medication because it enables the side-effects to be minimized.

3.2.8.8 New methods of treatment

The boom in biotechnology and genetic engineering triggered a rash of company startups around the turn of the millennium, particularly in the European economic heartland and in Northern Europe. Since then these regions have developed into medical equivalents of Silicon Valley. Restrictions in one country – regarding active use of genetic engineering techniques, for example – can be circumvented by collaborating with other countries within the European Union (like Estonia) where similar restrictions do not apply. It is now possible to prepare individual genetic profiles. With these profiles, clinicians can identify, and partially correct, specific genetic defects, including certain forms of cancer and diseases of the immune system. Another landmark success has been the deciphering of the proteins contained in the body's cells, a process now nearing completion. This crucial advance will enable dysfunctional tissue and organs to regenerate or be replaced. It is now also possible to correct severely impaired vision and hearing with the aid of neuroprosthetics. Telesurgery has become an everyday process. By and large, surgeons have long since exchanged their scalpels for joysticks.

These technological advancements in the field of medicine, however, do cause patients anxiety and impede their decision-making, in spite of how well informed they are. Thus, the demand for health care personnel to counsel patients and look after them after a period in the hospital has risen in tandem with the use of high-tech medical equipment and treatment methods. At the same time, alternative forms of medicine are making a comeback. There are signs of a paradigm shift away from attributing the majority of diseases to an adverse genetic predisposition or functional problem at the molecular level and toward a more holistic view of human health.

3.2.9 Eating habits

3.2.9.1 Everyday food

How and what people eat depends first on their income bracket, and second on the interest they take in nutrition. For a large segment of the population, the price rather than the quality or the amount of processing foodstuffs have undergone is what counts the most.

There is a distinct difference here between the rich and the poor, and the slim and the overweight: Less well-off families purchase cheaper, processed food (e.g., tinned, precooked, and artificially enriched foods), whereas the more wealthy can afford up-market, organic foods and tend to pay careful attention to current health trends. However, a number of organic staples are now being mass-produced and offered at affordable prices, putting them within the reach of less affluent segments of the population.

People are relatively unconcerned about genetically modified foods, not just because these have gradually crept into stores in recent years without receiving much bad press or sparking health scares, but also because the makers claim they have beneficial effects on consumer health. The quantity of pharmaceutically enriched “sanity foods” on the market has also risen sharply – products like anti-depression bread, cheese capable of balancing the body’s hormones and yogurt containing headache medication.

Convenience food in all its varieties has conquered supermarket shelves and has become the dominant food product, particularly in cities with a high proportion of single-person households.

There are frequent scandals surrounding intensive livestock farming and cheap imports from non-EU countries, but consumers have grown accustomed to them. Given that the daily news is full of disturbing reports on terrorism, joblessness,

Scenario 2 – Life in the year 2020 – Eating habits

environmental problems and the like people take these scandals in their stride and tend only to call boycotts of particular foods in response to serious threats to their own health.

3.2.9.2 Theme food

People often eat out (at their third place, for instance). Restaurants outside the snack and fast-food sector are rated more on their status and atmosphere than on the quality of the food they serve. People want to experience something special, they want to dine in the right company and in the right surroundings, and good restaurants offer precisely this kind of experience. Since these restaurants are usually located in vast shopping malls, they help round out the impression of a perfectly orchestrated consumer world.

3.2.9.3 The nuisance of cooking

People largely regard food as nothing more than a “fuel” source and therefore tend either to prepare and consume it on-the-fly at home or to eat out, because with their multiple jobs and many leisure activities, having to eat at all is regarded as an annoyance. The more health-conscious prefer to use methods of preparing food that are gentle and preserve the vitamins but are quick nonetheless.

Even in Southern Europe, home cooking, once a skill traditionally handed down from generation to generation, has now been lost to posterity. When people invite others over for dinner (a rare occurrence on account of the preference for the many activities outside the home environment), the meal is usually ordered from a delivery service, because hardly anyone has sufficient time to cook at all, and catering for a large number of people has become something of a lost art.

3.2.9.4 Faster food

Europe's consumption of fast food has long since attained the same scale as in the USA, and the most common lifestyle disease is obesity. Although many fast-food chains now offer low-calorie dishes (to avoid lawsuits by consumers, for

example), the fat and calorie levels in these foods, most of which are consumed standing up, in front of the TV or at the computer, remain far too high. To compensate for the vitamin deficiencies that accompany a diet of fast food, people reach more and more often for vitamin and regenerative products that promise plenty of energy and robust health. In addition, ready-to-eat snack foods are replacing regular, one-course meals in restaurants. Restaurants commonly also double as fast-food places. Their standing areas are generally larger than their seating areas because the demand for sit-down meals is declining steadily.

3.2.10 Education

3.2.10.1 Education standards in Europe

Society's economic and social extremes are also reflected in the education sector. A gradual erosion of subsidies means that public institutions are struggling to maintain standards and can offer nothing more than a minimum education. On top of this, they have failed to keep up with private education providers, at least as far as educational and research expertise are concerned. Young people's future employment prospects thus depend on parental income levels, because attending public educational institutions offers just a rudimentary schooling and an education in a private institution is an important prerequisite for future employability.

3.2.10.2 Private education companies

Private education providers offer a broad range of university-level degree programs, many of them cross-disciplinary, and for the most part international in orientation so as to enable students to study at multiple locations and still obtain their desired qualifications without wasting valuable time. However, this only works if students remain with one and the same education provider, because each one has its own specific offering of courses and services and its own distinct program structure.

Scenario 2 – Life in the year 2020 – Education

Virtual education programs afford greater flexibility in terms of place, allowing students to complete internships at more out-of-the-way locations without having to interrupt their degree programs. Education providers also offer grants and scholarships to help high potentials whose parents are unable to offer them the financial support they need.

A reduction Europe-wide in the number of years spent in school means that people can embark on degree programs sooner and complete them faster. Given that Anglo-American higher education models based on a standard three-year bachelor's degree have become commonplace, young people embarking on careers now receive training on the job instead of beginning work already equipped with extensive expertise in their chosen field. Extensive specialist knowledge from a university would in any case be of little value in the event of a complete change of job, and today, patchwork biographies are nothing unusual anymore. In light of the trend toward starting work at an earlier age, the number of people completing doctoral degrees is on the decline.

Adult education has burgeoned into a highly profitable industry. Private universities in major population centers are offering programs for people of any age and experience level. The even spread of age groups within the student body enables younger members to benefit from older members' work and life experience. Outside the main population centers, leading education providers' branch offices offer an extensive range of distance learning programs.

The types of employment contracts offered by private education providers have become more flexible and now include limited-term full-time and part-time employment and visiting professorships. As a result, there has been an upsurge in the number of managers from industry working at schools and universities as a sideline. Each private education provider has on its books at least one or two eminent authorities – worldwide experts in their fields – whose cachet serves as an advertisement and sharpens the provider's competitive edge in the highly competitive international education marketplace. E-learning specialists and experts in new methods of learning also work for these companies alongside full-time and part-time lecturers and practitioners.

These efficiently run private education companies, with their highly organized management teams and polished public relations work, are in a position to raise quality standards, train the most talented students and attract the big names they need to heighten their reputations – partly through their contact networks and partly thanks to donations and sponsorships. Their campuses are equipped with all the latest technology, including virtual labs in which students can work with 3-D simulations in near real-life conditions, as well as e-learning systems that enable them to attend lectures remotely from a number of locations and to interact with the teaching staff.

University graduates' chances in the labor market largely depend on how much money they have invested in their education. The career prospects for graduates of elite universities are especially good. (Here, too, an Anglo-American system of education has become established in Europe.) These elite schools, with their strong reputations and, not uncommonly, with affiliated research facilities supported by generous private donations and corporate grants, are able to find the best posts for their graduates.

3.2.10.3 Forms of learning

There has also been a marked transition in the way that knowledge is imparted. Cross-disciplinary learning, for example, has now become firmly established in schools and in places of higher education, because it helps students to get to grips with the complexity of knowledge and makes it easier to deal with frequent changes of job (now very much the norm in working life). One outcome of this move to cross-disciplinary learning is a rise in the number of people who work for several companies at once as well as the number of accomplished all-rounders who are capable of succeeding in a wide variety of different jobs.

In everyday education, old-style “chalk and talk” tuition has been superseded almost entirely by workgroups with flexible learning objectives and interactive tuition. There has been a radical paradigm shift – away from purely factual knowledge to a more holistic education where the focus is on deliberation, methodology and social skills. The reasons for this are rooted in the instability of today's society.

3.2.10.4 Public versus private education

The debate surrounding public versus private school education has become heated because public schools only offer a basic level of knowledge and are equipped with outdated technology, thus widening the digital divide. This divide is already evident in public primary education, where the IT equipment available and the low standards of knowledge among students score poorly in comparison with the infrastructure and students' IT skills in private schools.

In addition, violence has increased in public schools to the extent that fights and beatings are by no means the exception. The kind of psychological counseling given to problem students in private schools is simply unfeasible in the public sector due to the lack of staff. All this has a negative impact on classroom teaching, with the result that students with standard public sector qualifications are difficult to place. This deficit is tempered somewhat by continued efforts on the part of public sector education providers to adopt elements of the Scandinavian school system, which has succeeded in preventing many of the problems typically encountered in schools in Europe's economic heartland by pursuing targeted initiatives to prevent violence and to build social competency among students.

The enormous differences in the quality of education offered by public and private providers has spawned a European education elite, who now run industry everywhere from Moscow to Lisbon and who stand apart from the rest of the population with its average education.

3.2.10.5 Knowledge management

The World Wide Web is now more ramified and chaotic than ever, and no efforts to structure the vast amount of information available on the Internet have yet succeeded. Thus, the only way to pool information is to use selection procedures supported by meta search engines. Knowledge management teams at schools and places of higher education have become key figures in the education sector, and knowledge management degrees are now among the standard

courses offered at every educational institution. Working on complex topics is impossible without first putting together the right team, because everyone is now reliant on others' knowledge. The process of separating the information wheat from the chaff and hunting for credible sources is becoming increasingly time intensive. Educational institutions are networked at the regional, national and international levels, and today benefit greatly from access to a global network of knowledge.

The war on plagiarism has achieved initial successes, with schools and universities now using software to determine whether student essays, undergraduate theses and doctoral theses have merely been copied and compiled from other sources or are bona fide original pieces of work.

3.2.10.6 Internet content and user protection

To date, the originators of works enjoy no effective copyright protection because it has been impossible to enact unified legislation. However, in recent years a higher degree of user protection has been achieved. This has become necessary because knowledge often grows steadily through originators' interaction with users and the critical comments and suggestions for improvement these users make. This means that knowledge is actually processed and developed to a greater degree by its users than by its originators.

Searching for high-quality, free content is a process that calls for plenty of time and stamina, and users need to carefully process the content they locate. Freedom of opinion and freedom of speech remain cornerstones of the World Wide Web.

3.2.11 Security

George Orwell wrote his science-fiction novel *1984* in 1948. For readers at that time, the scope of Big Brother's surveillance infrastructure was something utterly inconceivable. Thirty-six years later, in 1984, the kind of future depicted in the book suddenly looked possible, given the latest technological advances, but was seen as something only likely in dictatorships. Today, a further 36 years on, people are wishing that the surveillance systems in place would actually succeed in containing terrorism and crime.

Businesses, event organizers and wealthy private individuals hire private security services to provide protection. This is a rapidly growing market in which specialist companies offer clients a range of packages based on service level agreements. Public authorities provide these companies with a basic workload by hiring them to watch over train stations, airports, key nodes in the transport infrastructure and public events. However, these businesses generate the majority of their revenues through the protection of private individuals, sports and cultural events, corporate campuses and business premises. Detection systems, sensors and surveillance cameras are installed as a means of early threat detection. But as detailed analyses of security scenarios reveal, the human factor remains the most critical when it comes to putting reliable security in place.

The security technology market thrives on innovation. In a time in which people and their belongings are screened at every train station, in every hotel, at shopping malls and at cultural and sports events, and in which apartment buildings and businesses' plants and offices are under constant surveillance, the market for state-of-the-art equipment is a lucrative one. Recent developments in this field include new biometric systems that are capable of identifying individuals with absolute precision.

Even though companies are prohibited from storing and retaining surveillance material and may only use such material for security purposes, cases of abuse are rife, sparking a heated public debate on whether surveillance should be permitted at all. At the end of the day though, society has had to give in to the necessity.

Heavily protected residential areas have changed the appearance of city precincts. Driven by a need for greater security, people are moving to modern residential “strongholds,” walled complexes with extensive housing areas, parks and just a handful of access points that are monitored 24 hours a day. Cut off from the public at large, these complexes offer a secure, semipublic environment, a space in which people can go about their lives in safety and where children can play outdoors.

4 Siemens' Technology Reports

The following "Technology Reports" from Siemens provide short overviews of possible future developments in major fields of technology.

Key statements from the reports have already been incorporated into both the previous scenarios. However, their full texts have also been included in the final report, since they offer important additional information about possible futures – considered from technical, scientific and economic points of view.

The Technology Reports are based on "Pictures of the Future," a publication of Siemens' Corporate Technology Department. In cooperation with the various Siemens Groups, the company's research department uses this tool to identify developments that may impact the world of tomorrow and to systematically examine all the trends – social, economic, technological, market and customer-related – that could affect Siemens' businesses in the future.

The statements in "Pictures of the Future" and in the Technology Reports have been generated by combining two opposed but mutually complementary methodological approaches: extrapolation from the world of today and retropolation from the world of tomorrow¹).

"Pictures of the Future" is the result of the collaborative efforts of a wide range of scientists and other experts. For this reason, it seemed appropriate to utilize its analyses and scenarios and their scientific and technological expertise for Horizons2020.

¹ Further information on the methodology used by "Pictures of the Future" is available in: "Pictures of the Future, Strategic Visioning at Siemens," Siemens AG, Corporate Technology (publ.), Munich 2004.

4.1 Production and Automation Systems

Dr. Carl Udo Maier, Siemens Corporate Technology, Munich

Most important trends

- **Digital engineering is linking the virtual and real worlds.**
- **Production is global and based on a networked division of labor.**
- **Manufacturing services are oriented toward total products and process life cycles.**
- **Intelligent buildings are networked and communicate with service providers.**
- **Individual logistics are based on end-to-end product traceability and transparent transport processes.**
- **Automated laboratory processes are shortening innovation cycles.**

Abstract

IT penetration, worldwide networking and customer-specific requirements are the key features of industry, trade, logistics and building technologies. Globally networked development centers are driving rapid market-oriented innovations in products and solutions. High-performance modeling and 3D-visualization methods are helping merge the real and computer-generated virtual worlds. Due to strong global competition and ever-shorter innovation cycles, production in the process and manufacturing industry is based on localized global presence and networked cooperation. Flexible production systems are easy to integrate and operate. The availability of all relevant information at all times and places is helping ensure the optimal coordination of specialized tasks along the entire production chain. The use of condition monitoring systems has eliminated the need for preventative maintenance, since production conditions are monitored online, making it possible to conduct condition-oriented repairs. Intelligent buildings are networked and communicate with their surroundings. In the field of building technologies, the networking of intelligent products and systems is maximizing individual convenience and security. Conventional sales

and marketing have lost much of their importance. Online shopping and e-commerce have led to an increase in the number of small-scale transport units. As mail-order volumes grow, more and more transport companies, each requiring an individualized logistics system, have sprung up. The end-to-end traceability of products along supply chains is now a reality. Highly automated laboratory processes have led to ever-shorter innovation cycles. Highly integrated, miniaturized and chip-based laboratory processes have given rise to rapid and mobile analytic and diagnostic procedures.

■ Digital engineering is linking the virtual and real worlds.

Future trends

Computer-aided simulations are being used at a large number of development centers worldwide. Developers work on a global and interdisciplinary basis to rapidly generate market-oriented products and solutions on computers. High-performance modeling and 3D-visualization methods are helping merge the real and computer-generated virtual worlds.

- Due to increasingly individualized customer requirements, new systems, products and production processes are being created at research and development centers around the world. Knowledge, based on computer-aided models, is transferred between participating customers, systems operators and R&D centers on a continuous basis. The inclusion of suppliers and customers in the development process ensures optimal product development, since all interdisciplinary know-how is pooled in this process. This applies particularly to so-called “mechatronic systems,” which contain mechanical, electrical and software components. Innovative products increasingly include large amounts of software, innovative materials and miniaturized components. The use of quantum-mechanical effects, in particular, is generating further increases in systems’ computing power.
- Computer models can describe all of a product’s physical properties and functionalities in a very short (real) time. High-performance simulations can calculate and test these properties and functionalities under realistic conditions, accelerating market-oriented optimization and making it possible to

generate a large number of product variations. The use of sensors in virtual tests of a product's noise-, smell- and vibration-producing properties is now commonplace.

- In so-called “digital factories,” products and production processes are simultaneously calculated and optimized for both the manufacturing and process industries. Computer programs simulate production facilities as well as complete logistics supply chains – from supplier to end-customer – for the entire manufacturing process.
- A computer-aided description of products and production processes is used for educational and training purposes. In simulators, test subjects and developers assess products and their functionalities in various environments under real-time conditions. Systems commissioning, operation at optimal working points, maintenance and updates are tested using virtual, three-dimensional computer images. Simulators also describe complete logistics processes and energy-efficient procedures for buildings. For this purpose, trainers use wireless and portable computers as well as augmented reality goggles, which combine real and virtual images.
- **Production is global and based on a networked division of labor.**

Future trends

Productivity and flexibility in the process and manufacturing industry are steadily increasing. Global presence, due to strong global competition and ever-shorter innovation cycles, requires networked cooperation. Production systems are easy to integrate and operate. The availability of all relevant information at all times and places is helping ensure an optimal integration of separate tasks along the entire production chain.

- The total integration of information technology – from end-customer via producer to supplier – yields a high degree of transparency at production facilities and guarantees complete data transparency for the fast and flexible implementation of individual customer requirements. Suppliers are increasingly flexible providers of systems integration and solutions rather than merely manufacturers of products. All-in-one service providers, who are integrated into networked business processes, perform comprehensive service tasks for industrial enterprises and consumers. Corner factories

employ flexible, fully automated processes to produce goods – particularly, less complex products and spare parts – at locations close to the customer.

- Suppliers, who increasingly provide comprehensive services that are outside their customers' core competencies, deal with volatility in customer requirements through rapid changes in production and highly flexible production processes.
- E-business software solutions lead customers directly to the products they need and register their individual purchasing behavior. User-friendly software and service center support make the actual ordering and payment process easy and secure.
- Automated order planning ensures an optimal, worldwide, around-the-clock division of labor (follow-the-sun principle) for filling customer orders. The quality and speed of such order processing and planning largely determines actual production planning at production facilities.
- Order planning helps ensure that necessary capacities are reserved for the customer and that planning and simulation technologies are used to flexibly tailor production processes to meet specific customer requirements. Virtual products and production systems simulate and optimize a wide range of manufacturing procedures parallel to actual production and, hence, make possible the run-up of production systems. Modular software systems are integrated into company-wide logics for achieving company goals and continuously linked from the production to the management level by intelligent networks. Software agent systems provide information to the decentralized modules and thereby link information acquisition with the location of the control process in real time, making automation systems increasingly autonomous and enabling them to cooperate with other process flows. These autonomous systems make decisions on their own and reduce the complexity of the entire manufacturing process.
- The complete integration of automation solutions, of intelligent sensors and actuators all the way to the management level, provide end-to-end information access in global company networks by linking production, logistics, building technology systems and energy distribution. Miniaturized, intelligent, self-teaching controls, which are decentralized and distributed to the locations where they are required, are being increasingly installed in field

devices. Control programs run on integrated computers (embedded systems). Optimization and diagnosis programs improve and evaluate productivity and reduce the costs incurred over the total lifecycle of products and production goods.

- Entry controls have been scaled back a great deal and new quality assurance mechanisms have taken over, especially at those points where quality can be most decisively improved. Broadband data transmission makes this information accessible to all partners along the supply chain and, with the help of the end-to-end local and historical traceability of products via wireless production monitoring methods, provides a quality management system that is transparent to the customer.
- New materials like polymers with metallic properties, high-temperature superconductors and ceramics are making new types of processing possible. Laser technology and opto-electronic components are being increasingly used. The trend toward ever-greater miniaturization has reached nano-dimensions, while production and testing units can master nano-sized measurements.
- **Services for production are oriented on the total lifecycle of products and processes.**

Future trends

High-performance IT tools that can be employed for implementation planning – that is, for determining which repairs are necessary when, which production units can reasonably be bundled and the resources this requires – are available for maintaining production facilities. The use of condition monitoring systems makes preventative maintenance unnecessary, since servicing is carried out using online assessments of a system's current "health status."

- Companies continue to focus on their core competencies. As a rule, secondary processes are outsourced to external service providers, who also offer maintenance and support for the processes and subsystems in their respective areas of expertise. At the same time, operators of production

facilities and external operators of secondary processes utilize the manufacturing know-how of suppliers like engineering firms, who have remote access to production goods for diagnostic and maintenance purposes.

- The use of mobile service robots and computer-aided service instructions to carry out on-site repairs, accelerate servicing and reduce overall maintenance costs are now widespread. Manufacturers of systems and machines handle the complete service business, including maintenance and repair. They analyze faults remotely, advise customers, eliminate defects and maintain systems.
- Maintenance providers operate centers of expertise and use virtual reality exchange and replacement scenarios to assess space needs and plan assembly steps, process optimization and resource utilization. Collisions and critical paths are identified in simulations. In addition, operators are trained in the assembly, commissioning and operation of components and systems which have been imported as part of maintenance and update measures. Operators of production facilities have remote, around-the-clock access to expert support. Remote monitoring and tracking of maintenance measures reveals plan deviations at an early stage.
- In production facilities, programs integrated into automation systems are used to plan maintenance implementation. These programs coordinate resources (equipment, material and personnel), plan schedules and deadlines, generate work assignments and control processing. They coordinate interfaces to neighboring facilities, provide operational data planning and organize entire workflows.
- Condition monitoring systems and wear models make it possible to forecast the condition-dependent maintenance of investment goods, future life expectancies, service life allowances, materials consumption and component wear. Numerous sensors provide the basic information needed for the appropriate wear models. Augmented reality supports on-site servicing. Local assembly personnel are also supported in implementing service and repair measures by centers of competence, so that only a few systems specialists are still required. Less-skilled local personnel are trained on a situation-specific basis and receive all required documentation online, enabling them to perform sophisticated tasks.

- **Intelligent buildings are networked and communicate with service providers.**

Future trends

Intelligent buildings are networked and communicate with their surroundings. Building technologies provide a high level of convenience and safety and help cut costs by making it possible to network intelligent products and systems in the areas of heating, climate control, ventilation, fire protection and security, for example.

- Intelligent products for heating, ventilation and climate control in buildings feature standardized communications capabilities which can be tailored to individual applications. Intelligent, low-cost sensors for presence and movement detection, multi-biometric identification systems and image and pattern recognition are the main technologies employed in these devices. Intelligent crowd control systems are used for directing people in emergency situations and for navigation in public buildings, for example.
- Adaptive heating / ventilation / climate control systems linked to other space management functions – for example, lighting controls, multifunctional facades with transparent solar cells, and electronic dimming – ensure individualized comfort while reducing energy consumption and operating costs. Controls and monitoring systems are based on wireless transmission technology and yield a high degree of flexibility in spatial design. Linking building applications to centralized data evaluation and analysis makes data more transparent and increases building productivity.
- Standardized plug-and-play products, which are linked via a uniform building control system, ensure easy installation and systems operation. The use of intelligent management tools for online optimized load profiles and supplier selection, for example, increases productivity in industrial buildings. Networked systems combine individual automation components and related maintenance services as needed. Building control systems network plug-and-play products.
- IT platforms for various applications in both production systems and buildings apply uniform standards and make it possible to link industrial processes (automation and drives systems, for example) with building automation systems (for security monitoring and energy savings). Open

communication between individual applications is based on globally accepted IT security solutions.

- Due to the need for flexible private and commercial spaces, modular building systems, which are based on modular infrastructure systems (water, gas, communications, energy supply and security systems, for example) and are linked via uniform interfaces, are used more and more frequently.
- Comprehensive services for electronic security monitoring in office buildings, production facilities and private homes supplement the current range of building management systems by providing remote monitoring and access from central monitoring stations. These security stations, which provide 24-hour service, are tailored to customers' individual business and personal needs. Event-controlled video transmission, alarm verification and personal identification systems are centrally monitored and the corresponding personnel (security services, fire departments and doctors, for example) are notified and supported locally. Efficient encryption and authorization programs provide a high level of security for information transmission and access authorization. Now that people are living longer and the quality of life enjoyed by senior citizens is increasing, advanced building technologies are enabling more and more elderly people to enjoy long and secure lives in their own homes.
- **Individual logistics are based on end-to-end product traceability and transparent transport processes.**

Future trends

Online shopping and e-commerce have led to the creation of smaller-sized transport units. As mail-order volumes have grown, more and more transport companies, each requiring its own customized logistics system, have sprung up. The importance of conventional sales and marketing measures has declined. End-to-end product traceability is now a reality.

- Companies have few internal logistics activities within their core competencies. Third-party logistics service providers manage internal company logistics and perform other related tasks, using high-performance IT systems to optimize entire supply chains. The planning, control and tracking of logistics flows is conducted via globally networked communications structures. Both logistics service providers and end consumers can follow the entire

logistics process in real time with automatic tracking and tracing systems, monitor product condition by means of integrated sensor systems and intervene via actuators, where necessary.

- Intervention in the logistics process requires a high degree of flexibility. Highly automated and modularly structured warehouses and spare parts depots guarantee minimal inventories with sufficient availability and provide extremely short access times. Identification, handling and robot technology as well as open warehouse management systems are available for optimizing stock-keeping and online inventories. Driverless vehicles with flexible superstructures make loading and unloading more flexible.
- Logistics is planned as a holistic process. Although intelligent distribution centers, so-called “cross-docking stations,” produce some interruptions, they also help optimize the flow of goods by enabling the efficient utilization of transport capacities and end-to-end, multi-module processes involving various types of transport – ship, train and truck, for example.
- Intelligent cross-docking centers efficiently route large-volume shipments. High-performance identification and sorting systems, which ascertain storage capacities before goods are received and can thus optimize warehouse and sorting management, are used for this purpose.
- Hybrid mail marketing facilitates customer-specific marketing tailored to the interests and behavior of individual purchasers. Marketing materials are digitally assembled and dispatched to the local distributor for “the last mile.”
- Using total information networking, logistics service providers form so-called “virtual ad hoc companies” that cooperate over the last mile to the customer. Software agents identify possible partners for optimal transport operations and autonomously negotiate the scope and length of their cooperation.

- **Automated laboratory processes are shortening innovation cycles.**

Future trends

Highly automated laboratory processes have led to ever-shorter innovation cycles. Compact, miniaturized analysis systems are used in lab processes. These mini-labs are especially useful for fast quality control and in healthcare diagnostics. A reduction in the number of mechanical and logistic interfaces between individual systems makes it possible to carry out chip-based laboratory processes and to increase the speed and mobility of analytic and diagnostic applications such as the online quality control of food and beverage production.

- A high degree of systems integration (IT solutions) – involving everything from the storage, transport and preparation of samples to the archiving and assessment of the results of large-scale experiments – is helping optimize machine utilization. Experiments are conducted at very high speeds, with optimal planning reliability and a zero fault rate.
- Interdisciplinary databases are interlinked. Research results, based on heterogeneous data and knowledge, are distributed worldwide. Scientists from a variety of different fields have worldwide user- and format-conform access to this information. Algorithms and software solutions for database systems, network architecture, data integration and communications are used to achieve this. Intelligent software agents can identify the relevant research institutes and cooperation partners automatically.
- Experiments are simulated by high-performance modeling software. Self-teaching algorithms support combinational methods to drive rapid trial-and-error materials development. Based on precisely calculated results, experiments are efficiently conducted using on-a-chip systems in which large-scale trials and trial analysis can be conducted. A large number of experiments and analyses are carried out simultaneously on a single chip. Scanners that can read and process optical and electrical signals are used to register and evaluate the results of large-scale experiments. In lab-on-a-chip systems, a number of laboratory processes – those involving micro-reactors, micro-pumps and micro-fluidics, for example – are integrated on a single chip. Such systems are mobile, intelligently networked and useful in on-site analyses.

- The development of individual pharmaceutical materials is based, for the most part, on genetic findings and biological procedures. The identification of disease-relevant changes in genomes and proteins enables researchers to devise new diagnostic and therapeutic methods. Algorithms and software solutions for analyzing and interpreting molecular biological data are the basis for this new knowledge.
- Leveraging the results of molecular genetics research – so-called “microfabs” – produce individually tailored materials. They also link laboratories with production processes more closely and permit the rapid production of materials in the precise amounts needed. The process parameters for large-scale commercial production are defined at the same time.

4.2 Power Engineering

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Most important trends

- Energy demand
- Deregulation
- Oil
- Synthetic fuels and biofuels
- Natural gas
- Hydrogen and fuel cells
- Fossil-based power generation – CO₂ reduction
- Decentralized power generation – Fuel cells
- Nuclear power
- Renewable energies
- Power grids
- Mobile / portable power supplies

Abstract

Growth in energy demand – particularly, the increased demand for electricity – has been only partially offset by improvements in efficiency.

The deregulation and harmonization of power markets has been accompanied by ever-greater re-regulation, which includes state intervention in the energy carrier mix.

In 2020, we are still using primarily petroleum-based fuels for road vehicles. Synthetic fuels made of gas or oil sand are gradually appearing on the market. To cut carbon dioxide emissions, conventional fuel is now mixed with 20% biofuels without customers noticing.

To ease bottlenecks in regional supplies, natural gas is now sold in liquid form (LNG) worldwide.

Today, energy companies use hydrogen in two main applications: transportation, particularly in limited-range fleets, and as an intermediate product in zero-emission coal-fired power stations.

Advances in materials development and intelligent monitoring have further increased the efficiency and reliability of fossil-fuel power plants. Today's zero-emission plants are based on entirely new concepts: carbon dioxide is separated in the power plant process and permanently stored in geological formations.

Large power plants that work together in interconnected grids are the backbone of the European power generation sector. Since the cost of fuel cells has fallen below €600/kW, these cells, which have been installed in more and more private homes, are used not only for combined power and heat generation but also to back up distribution networks.

Many countries are supporting the construction of new nuclear power plants with financing guarantees and other types of assistance. Prototypes of “fourth-generation” technology have already demonstrated that nuclear energy can be economically feasible without producing problematic, extremely long-lived radioactive materials.

Hydroelectric power, by far the most economical form of renewable energy, has expanded – mainly in Asia. Due to a massive development policy, nearly 100 GWs of wind turbine capacity have been installed in Europe. Solar chimney, solar thermal and tidal power plants have been implemented in a variety of pilot and prototype projects.

Asset management is the new yardstick for grid operation and maintenance. It involves operating plants at their physical limits and optimizing maintenance strategies. Transmission grids have merged on a continental scale. With the use of renewable energies, long-distance transport is now more important than ever before.

Dramatic reductions in the energy requirements of all kinds of communications equipment as well as improvements in batteries, fuel cells and entirely new miniaturized systems to “harvest” ambient energy from light, vibrations and temperature variations are making ubiquitous computing a reality.

■ Energy demand

Economic and population growth particularly in threshold countries has sharply increased energy demand. Growth in energy demand – particularly, the increased demand for electricity – has been only partially offset by improvements in efficiency.

Population growth – primarily in Africa, India, China and other Asian countries – migration to the cities and growing urbanization have caused population increases primarily within urban structures (95%). Population growth in Europe, on the other hand, has stagnated. It will not be long before we will have to meet the energy needs of roughly eight billion people worldwide.

The enormous economic growth rates achieved before the turn of the millennium have not been sustained – even growth in primary energy demand has dropped below the peak figures from the 1970s to the 1990s. Declining energy intensity has partially compensated for the rises in energy demand resulting from an average economic growth rate of 3%, particularly in developing and threshold nations. Consequently, primary energy demand has increased 1.8% every year since 2000.

More efficient industrial processes have slowed the growth of primary energy demand in the industry sector to an annual rate of 1.6%. The most noticeable efficiency increases have been in the areas of space heating and cooling. Low-energy and passive-energy houses, which were still pilot projects at the turn of the millennium, are now standard in new construction, due in part to their extreme convenience. However, the renovation of old buildings is accounting

for the lion's share of efficiency gains. Governmental regulations have been imposed across Europe following climate policy pressures in the period from 2008 to 2012.

As in the past, the highest annual growth rates have been reported in the transportation (2.2%) and power generation (2.1%) sectors. Transportation is still primarily petroleum-fueled, although synthetic liquid fuels based on natural gas have been added to the mix in the last few years. Convenience and the penetration of communications technology into all spheres of life have further spurred growth in energy consumption by a substantial 1.6% per year, even in Europe, where primary energy demand has been increasing at a comparatively modest rate (0.9% per year).

■ Deregulation

The deregulation and harmonization of power markets has been accompanied by ever-greater re-regulation in areas like environmental charges and emission quotas as well as national targets for the energy carrier mix.

The actual drivers of deregulation – namely, avoidance of uncompetitive high prices and incentives for greater economy – are still as effective as ever.

Europeans have harmonized their regulation landscape in a continuous interplay between more powerful oligopolists and more cooperative regulators. Combined with technical requirements – namely improved power transmission routes to regions such as Eastern Europe and Scandinavia – this has made it possible to buy and sell power on a Europe-wide scale. The international trading of short-term capacity adjustments based on regulated capacities – which have become increasingly necessary through wind energy flows, for example – is a new development.

Many developing and threshold countries initially attempted to deregulate and privatize their energy markets simultaneously. Later, however, more and more of them discovered that, in order to attract the enormous foreign capital needed

(over \$3 trillion just for power generation in the period from 2000 to 2020), a gradual approach (first privatization, then deregulation) made more sense in regions that have only gradually achieved political stability.

The paradigm at the turn of the millennium – summed up in the phrase “a free energy market is the most efficient way to achieve cost-effective power supply” – has been supplemented in the last few years by a strong trend toward re-regulation, which affects environmental issues and emissions policies as well. Trade-based mechanisms such as “cap & trade,” which was tested in the United States in the early 1990s, have become standard practice in Europe. Cap & trade involves setting a reliable overall volume, allowing emissions trading and permitting the players to determine which technology is the most economically efficient.

In response to increasing dependence on imports and hard-to-control terrorist activity, the important question “Which mix of energy carriers should we base our supply on?” has been increasingly answered at the governmental level. Europe’s gas supplies have become a key issue in relations with Eastern Europe, with the result that Russia is now linked to the European grid. A consistent policy to develop clean coal-fired power stations during the first decade of the century was an important reason why the conversion of price-stable imported coal to electricity remained marketable in the second decade despite environmental restrictions. The importance of coal for hedging gas price risks has increased, first in the United States and later in Europe.

■ Oil

Today, we are still using primarily petroleum-based fuels for road vehicles. Conventional oil production is increasingly concentrated in the Middle East. Because price levels have remained high for years, synthetic fuels made of gas and oil sand have gradually appeared on the market.

While the use of oil in power generation is now largely focused on applications where no natural gas infrastructure is in place, road vehicles have continued

to be nearly as dependent on fossil fuels as before. Consequently, the global demand for oil has risen at a relatively stable rate of 1.7% a year over the last two decades.

On the other hand, many oil extraction sites, such as those in the North Sea and in North America, were already exceeding their extraction limits as early as the turn of the millennium. Although these sources are still producing oil economically, the high annual production volumes of the 1990s can no longer be maintained at a reasonable cost. As a result, imports from the politically unstable Middle East have risen. Following a long interruption during the first decade of the century, large-scale investments in Middle Eastern production infrastructure have resumed, so that the necessary production capacities have now been achieved. Increasing dependence on imports has given rise to a number of countermeasures.

New drilling methods (horizontal drilling) have been used to further exploit existing fields. Enhanced oil recovery (EOR), which involves injecting carbon dioxide into nearly exhausted fields, thins the remaining crude oil, which is highly viscous, so that high extraction rates can be maintained.

Drilling platforms have ventured farther out to sea, to depths of up to 2,000 meters. The use of new materials and highly reliable automation systems that allow extraction and processing equipment to be shifted to the ocean floor and operated there for decades without maintenance have made this economically feasible.

New regions have also been developed – most of them outside OPEC – in West Africa, in the Gulf of Mexico and around the Caspian Sea.

In 2002, Canada became – practically overnight – the country with the world's second largest oil reserves. The technology needed to break down oil sand had advanced to the extent that the oil sand deposits in the region around Alberta could be extracted economically – the criterion for classifying such deposits as reserves. Ten percent of Canadian industrial investments went into the con-

struction of oil sand production infrastructure. The first step was to construct large open-pit mines. Next came “in situ” methods which use heat to remove heavy oil from the ground. By 2010, production capacities had reached three bbl/d (billion barrels per day), which means that Canada could satisfy up to 5% of global oil demand. For several years now, production facilities have also increased in Venezuela and Russia. A substantial obstacle has been the fact that large amounts of carbon dioxide are released in the course of the very energy-intensive process of oil sand production. Having ratified the Kyoto Protocol, Canada has been forced to buy carbon dioxide emission rights from other countries on a large scale – a cost which it easily finances, however, through earnings from oil exports.

■ Synthetic fuels and biofuels

Unbeknownst to customers, gasoline at the pump now comprises both biofuels (20%) and conventional fuels (80%) in some European countries, enabling the automobile industry to meet carbon dioxide emission requirements.

In the past, natural gas was often a by-product of oil exploration and extraction. Although it could be extracted economically in many parts of the world, the cost of transporting it to consumers through pipelines was often prohibitively high. Known as “stranded gas,” this resource accounted for one third of total gas reserves. The development of highly efficient catalysts have enabled scientists to dramatically improve the Fischer-Tropsch process, which has been around for the past 100 years, and make it possible to convert stranded gas into liquid fuels such as synthetic diesel at a competitive cost and to transport it over vast distances to the consumer. In 2011, Shell commissioned one of the first liquid fuel production plants in Qatar. In 2020, however, stranded gas still accounted for only a little over one percent of the world’s fuel supplies.

Such synthetic fuels are much cleaner than refined oil products, and their combustion properties can be very precisely and consistently determined. As a result, synthetic fuels were first used as additives in conventionally produced fuels and in order to bring fuel quality into line with local requirements. However,

advances in internal combustion engines have improved fuel quality to the point that, by 2010, synthetic diesel was the fuel of choice for even cleaner and more efficient engines.

Cutting carbon dioxide emissions remains a major challenge in the transportation sector. As a result, in addition to further boosting efficiency, more and more manufacturers have chosen to use biologically generated fuels that are free of carbon dioxide. The construction of separate infrastructures for fuels such as biodiesel in the late 1990s proved to be impractical: too many obstacles had to be overcome in the areas of engine technology and customer acceptance. In the end, voluntary commitments on the part of industry, combined with quotas, resulted in the integration of biomass (initially based mainly on biological waste) and a variety of other biofuels into synthetic fuel production. The biofuel proportion of nearly 20% is therefore unnoticed at the pump.

■ Natural gas

The continuing trend toward natural-gas-based power generation has resulted in high demand peaks and correspondingly volatile prices. To ease bottlenecks in regional supplies, natural gas is now sold in liquid form (LNG) worldwide.

The ongoing natural gas boom, particularly in the area of power generation, has meant that production capacities reached their limits on the market at the beginning of this century – mainly in the United States, but also in Europe. In some cases, spot market prices have peaked at ten times their normal levels. Prices have risen overall. It is not that natural gas reserves have been inadequate – they will still be sufficient for many decades to come – but rather that it has not been possible to expand the extraction infrastructure quickly enough to keep up with demand over a longer period of time.

Volatility and high price levels have brought about long-term structural changes. The transport of liquefied natural gas (LNG) has become profitable even to places where gas was previously transported by pipelines. By 2010, large liquefaction plants, transport ships and terminals for re-vaporizing natural gas had

been constructed. Continental natural gas markets were still separate in 2000. However, a global LNG spot market had brought them together by 2010.

Although natural gas continued to be discovered as a by-product of oil exploration in the 1980s and 1990s, high price levels in the first two decades of the twenty-first century required exploration for natural gas alone. New deposits, some of them quite significant, were located in places like northern China.

The United States, long accustomed to meeting its own natural gas needs, gradually become a net importer, so that today nearly 30% of the country's demand is supplied by LNG imported from various other regions around the world.

■ Hydrogen and fuel cells

In addition to traditional chemical applications, energy companies now use hydrogen in two main applications: transportation, particularly in limited-range fleets, and as an intermediate product in coal gasification power plants, where carbon dioxide is separated before combustion and supplied to a storage facility.

Hydrogen has long been an important chemical base material for industrial applications. In the 1990s, visions of a “hydrogen economy” greatly expanded the possible applications for two main reasons: hydrogen's storage and decarbonization capabilities.

Storage capability:

Hydrogen is a “secondary energy carrier” – that is, an energy storage medium. This makes it a good choice for reconciling fluctuating supply with energy demand as part of an extensive renewable energy supply system.

Decarbonization capability:

Because hydrogen combustion does not produce any local carbon dioxide emissions, it is a useful “decarbonizer” especially in private transportation, where it could theoretically cut CO₂ emissions to zero.

The first aspect – renewable energy storage – is not yet viable. In terms of energy management, it is still more practical to transport and use electricity without first converting it into another form of energy. The time between generation and consumption is bridged by highly flexible peak-load power plants and the integration of major consumers into an energy management system. It will be some 10 to 20 years before renewable energies will constitute a large enough portion of the power supply to justify the use of remote power generators to store them temporarily as hydrogen.

However, the second aspect – decarbonization in private transportation – is becoming increasingly feasible. For one thing, the possibility of reducing carbon dioxide emissions through the use of more efficient engines has now just about reached its limit. In addition, the consolidation phase which occurred in 2005 was followed by successful advances in the development of fuel cells, which now equal internal combustion engines as far as design and convenience are concerned. The commercialization of fuel cell vehicles, which have been successful in niche applications since 2010, is now beginning to take off.

Fuel-cell development suffered bitter setbacks following its hype at the turn of the millennium. Deadlines had to be extended and many startups fell victim to consolidation. People realized that some ideas were piloted too early and too extensively and that important development steps could not be carried out with the necessary focus. The consolidation phase was used to process existing operating experience on the design level. Advances in microsystems (for auxiliary systems and economical production methods), nanotechnology (for catalysts and membranes) and computational materials science (selective design of highly effective catalysts through computer simulations on the molecular level) all played an important role here.

In a completely unrelated development, a breakthrough in hydrogen technology went largely unnoticed: large power plants can now convert fossil fuels – usually coal – into carbon dioxide and hydrogen prior to combustion through gasification and other chemical conversion processes. Carbon dioxide is deposited in geological storage facilities. The remaining high-quality hydrogen is used as

fuel in the actual power plant process. Fuel cells have not made many inroads in this area. Hydrogen continues to be burned in specially customized gas turbines and converted to electricity.

This “fossil hydrogen sector” is poised to revolutionize the entire power plant industry, since, in addition to the main product electricity and its by-product heat, which has been used in individual applications for many years, we now have another marketable by-product from the power plant process: hydrogen. Gasification power stations, which are practically emission-free, are built close to densely populated areas, where the by-product, hydrogen, can be transported economically to gas stations or distributed to consumers via a gas distribution network – just like city gas in the twentieth century.

■ Fossil-based power generation – CO₂ reduction

Advances in materials development and intelligent monitoring have further increased the efficiency and reliability of fossil-fired power plants. Today, zero-emission power plants are based on entirely new concepts: carbon dioxide is separated in the power plant process and permanently stored in geological formations.

Gas and steam turbines continue to form the backbone of the power generation industry. Revolutionary improvements are nearly invisible here. In the last 20 years, power plant development has experienced a reduction in lifecycle costs, the elimination of harmful emissions, further increases in efficiency, greater operational flexibility and the introduction of carbon sequestration to separate and store carbon dioxide.

As in earlier decades, the focus of the last 20 years has been on increasing power plant efficiency. In this connection, operators have pursued two main approaches: further leveraging the principles of thermodynamics and utilizing the superconductivity of certain materials. According to the laws of thermodynamics, the higher the difference between the temperature of a gas or steam entering a thermal machine (which converts heat into energy) and the temperature of a

gas or steam exiting a thermal machine, the higher the machine's efficiency. For gas turbines, this means that it makes sense to increase the average temperature at which a gas enters the first row of blades. To simultaneously prevent the formation of the air pollutant NO_x, however, the downstream combustion process has to be better and more evenly controlled. An important way to achieve this has been to use catalytic (or flameless) combustion on a large contact surface. Up until five years ago, it was necessary to provide internal cooling for the first row of blades, which are exposed to high temperatures, in order to prevent them from melting. This, however, inevitably removed thermodynamically valuable high-temperature heat from the process – heat that could actually be converted into electricity. Today, 200 megawatt turbines, in which fiber-reinforced blades made entirely of ceramic are used in the first row, are being tested. These blades no longer have to be cooled, which means that their full heat capacity is now available for actual conversion.

To further increase the temperature and thus the efficiency of steam turbines, it has been necessary to raise the steam parameters from 600°C and 285 bar to the supercritical range of 700°C and 350 bar. The strength of the steel was a major obstacle here – not so much in the turbines themselves, but in the pipelines, heat exchangers and other equipment. Suitable nickel-based alloys – which, following extensive component testing, were used a few years ago in demonstration power plants – became available in 2010. Another important step forward came with the development of nanocrystalline modified steels, which will make steam power plants with an electrical efficiency of over 53% a possibility in the years to come.

The use of superconductive generators has brought about significant increases in efficiency. Power plant generators convert the power supplied by turbines into electrical energy. Aluminum and copper wires have been used in the construction of these generators ever since their invention. The currents flowing through these wires generate heat, causing losses and other problems. Superconductive materials are cooled by liquid nitrogen. In this state, their resistance is much less than that of copper. Their efficiency, which is excellent in large generators, is thus increased by another 0.7%.

Taken together, these improvements have meant that the combined-cycle process – which combines gas and steam turbines – can now achieve efficiency levels of up to 64% (slightly less than 60% was considered state-of-the-art in 2003).

These higher efficiencies have helped cut fuel costs – an important part of life-cycle costs – for power plant operators. Maintenance costs (expenditures for spare parts as well as income lost from downtime for maintenance) are another major consideration for these operators. Longer turbine blade life cycles, an advanced measuring system that helps determine the most economical maintenance times and new methods to speed up on-site maintenance have also been key factors contributing to dramatic cost reductions.

The ways in which the different plants in a power park are used to generate electricity have changed continuously over the last 30 years – a development which has been neither seen nor felt by end-consumers. Established regional monopolies lacked the means to clearly divide plants into those that run at full capacity around the clock to meet basic power needs and those that can adjust their capacities in accordance with accurate forecasts and schedules to meet fluctuating consumer demand. The auction principle that replaced utilization planning by local suppliers in the wake of deregulation gave rise to the latter type of plant utilization. Plants with the lowest variable costs were always first in line. The fact that it was hard to bring plants with low variable costs online and that it sometimes took several hours to adjust their utilization rates was long a thorn in the eye of many operators. The situation came to a head when highly variable power supplies from wind farms increased in the first decade of the century. Conventional power plants increasingly faced two alternatives: either provide more short-term capacity or be shut down. Short-term capacity was traded in marketplaces set up especially for this purpose – sometimes at extremely high prices – a practice which only benefited operators of flexible plants. Today, power plants have no trouble meeting these requirements. Appropriate mechanical construction ensures that voltages within components do not exceed permissible levels even with frequent temperature fluctuations. Optimized instrumentation and control processes enable operating points to be

changed quickly without causing dangerous “overreactions” somewhere within the plant. Sophisticated software tools help power plant operators make decisions in real time as to which plants they should use to sell power on which markets over the short, medium and long term and thereby achieve the highest possible yield.

Coal-fired power plants long had a reputation as environmental hazards, and for good reason. However, this began to change substantially as early as the 1980s, when the installation of flue gas scrubbers became mandatory in some countries. Nevertheless, basic operations in these plants remained largely unchanged for a long time. Coal – a complex mixture of carbon, inert minerals, sulfur, heavy metals and water – was still ground up and burned with air in large, tower-like furnaces known as boilers. The unwanted by-products produced air pollutants like SO_x, fine dusts and heavy metals like mercury. Because, for geopolitical reasons, we did not want to abandon the use of coal, which was still abundant worldwide, a process – integrated coal gasification – which had been tested since the 1990s was brought to an economically feasible stage in the first decade of the century. In this process, a fuel – coal as well as refinery residues or biomass – is pre-burned in a reaction container to which a precise amount of pure oxygen has been added and converted into a synthetic gas. This gas is then chemically prepared and purified. Because the gas is now in a form that can be burned directly in a gas turbine, the combined-cycle (gas and steam) process that uses it is much more efficient than a steam-only process. The power generation process used in an IGCC (integrated gasification combined-cycle) plant is somewhat more expensive than that employed in a conventional coal-fired plant of the 1990s. However, IGCC plants had a competitive advantage after 2010 when pollution control standards were stricter and complicated and thus more expensive waste gas purification measures were necessary in conventional coal-fired power plants.

However, the greatest obstacle to coal-fired power plants has not been air pollution but CO₂ emissions, which are higher than those from gas-fired plants. In an initial phase, substantially increasing the efficiency of old power plants reduced carbon dioxide. However, it is now clear that efficiency increases alone

will not be able to cut carbon dioxide emissions 20% (!) by 2050 as required. The demand for dramatic reductions has already brought prices into the range of €60 per ton of CO₂ on the futures market for emission rights (futures are unconditional forward contracts that are traded on the stock market). Given such high prices, a technology tested after 2010 in several pilot projects has become economical: Carbon dioxide is separated before combustion and transported through pipelines to geological storage sites (such as exhausted gas fields or deep salt water layers) and stored there safely. To ensure public acceptance of this method, a large number of research projects were carried out in the years before 2010 to verify the geological requirements of safe CO₂ storage. IGCC power plants have proven to be a particularly good choice for further development into real zero-emission plants. In both the United States and Europe, broad alliances of plant builders and investors have constructed demonstration power plants that employ carbon sequestration – that is, zero emission power plants – and have made them ready for the market within the last few years.

■ Decentralized power generation – Fuel cells

Large power plants that work together in interconnected grids are the backbone of the European power generation sector. Since the cost of fuel cells has fallen below €600/kW, these cells, which have been installed in more and more private homes, are used not only for combined power and heat generation but also to back up power grids.

There is a good reason why large power plants were the key elements in the vast majority of power generation infrastructures in the last century: economies of scale. In other words, large-scale conventional power plants were cheaper than smaller ones in terms of output. Nevertheless, small-scale plants were also used in some cases because the waste heat they generated as a by-product could be used locally (cogeneration) and because they were less dependent on the power grid and possible power outages.

By reusing the waste heat produced in decentralized plants, we can save fuel and lower carbon dioxide emissions. For this reason, the promotion of cogen-

eration technology has become a key part of climate-change policies, especially in Europe. However, decentralized power generation has not yet been able to break out of its niche market.

The development of fuel cells is likely to change all this, however. Fuel cells employ a conversion process that takes place on a surface. Cost and output are primarily related to this surface. Consequently, the costs of fuel cells are less a function of size than those of thermal machines. This means that once fuel cells become economically viable, it will not matter whether they are large or small.

The fuel-cell hype at the turn of the millennium was followed by a period of disillusionment and consolidation. Some products were completely redesigned to meet targeted costs. However, some players had already invested so much in the technology that they aggressively pushed its development and got the first competitive stationary power generation system on the market by 2010.

Only in the last few years, however, have advances in the area of catalysts and other active materials brought the price of installed capacity below €600/kW. As a result, household power plants (using fuel cells) have now begun replacing conventional boilers. Heating firms are stocking and maintaining these plants as standard equipment just as they once did boilers.

Utilities had been preparing for this launch for a long time. Today, they offer fuel-cell contracting services to install and operate electricity- and heat-generating fuel cells directly on customer premises. Some of the resulting economic advantages are passed on to customers. In addition, owners of buildings do not have to pay for the boilers when they are still shouldering the substantial costs of construction. Utilities also benefit from intensive and long-lasting customer loyalty, which is extremely valuable in liberalized markets. In addition, they can access many hundreds and even thousands of such plants remotely and use them selectively as a sort of virtual power station – to moderate usage peaks and back up power grids in the event of malfunctions, for example.

Today, these small, decentralized plants still account for less than 10% of the total power supply, an amount that can be easily provided by existing networks. In the case of new buildings, however, where fuel cell heating is used throughout, power sometimes flows in the reverse direction into low and medium-voltage networks. In the last ten years, protection technology – the “fuses” for power grids – has been redesigned to deal with this problem.

■ Nuclear power

Driven initially by the wish to achieve self-sufficiency and then by the need to reduce carbon dioxide emissions, many countries are supporting the construction of new nuclear power plants with financing guarantees and other types of assistance. Prototypes of “fourth-generation” technology have already demonstrated that nuclear energy can be economically feasible without producing problematic, extremely long-lived radioactive materials.

In the wake of efforts to reduce carbon dioxide, and faced with increasing dependence on imported gas, many regions have refocused attention on nuclear energy. The first step was to extend the life cycles of existing plants by 10 to 20 years – a move which greatly benefited operators.

The obstacles that liberalized markets posed for conventional nuclear technology were difficult to overcome. Extremely high investment costs (compared to low operating costs) increased investment risks. Enormous plant capacities meant that a single investment decision required a great deal of capital. Problems with licensing and, in the end, consumer acceptance delayed construction and commissioning until it was virtually impossible to calculate the resulting risks. Finally, the incredibly long storage times required for radioactive waste were also a major stumbling block to worldwide acceptance.

Even innovations like the European Pressurized Water Reactor (EPR), which was developed in Europe in the late 1990s, were unable to overcome these obstacles completely. Developed as a joint German-French project, the EPR went online for the first time in Finland in 2009. Although the reactor far surpasses plants of

the previous generation in terms of construction costs and passive safety, it could not solve other problems as easily – namely, the huge amount of construction work required and the extraordinary encapsulation time required for the radioactive waste produced.

In addition to these evolutionary developments, the United States, Argentina, Brazil, the UK, Canada, Japan, South Korea, South Africa, Switzerland and France also developed entirely new concepts, known collectively as “the fourth generation.” Smaller plants with capacities of just a few 100 MWs (and thus offering possible economies of scope – that is, cost reductions from building many plants of the same type) are not the only advantages these concepts provide. The new plants are also designed to breed most of their own fuel and simultaneously convert the resulting plutonium into shorter-duration fission products (transmutation). In a first step, the Pebble Bed Modular Reactor (PMBR), a German development which was further developed under the leadership of South Africa, went online as a pilot project in 2015.

■ Renewable energies

Hydroelectric power, by far the most economical form of renewable energy, has been expanded – primarily in Asia. Today, wind energy is economical only if secondary costs are not counted. However, a massive development policy has resulted in the installation of nearly 100 GW in Europe. Other alternatives such as solar chimney, solar thermal and tidal power plants, which are currently being implemented in a variety of pilot projects, also present exciting possibilities.

Theoretically, hydroelectric power is sufficient to supply all the world’s electricity needs. Often, however, the best sites for hydroelectric plants are far from centers of consumption. As a result, international organizations currently monitor plans for such plants to ensure that rural resources are used responsibly and that the lives of people living in suitable locations are not unnecessarily disrupted by power plant construction. Over the last 20 years, 80% of new hydroelectric

construction has taken place in developing countries, primarily in Asia. Plans are now being made to integrate hydroelectric power generated in the Congo into the African and Southern European power grids.

In the years after 2008, massive wind energy development programs ran into enormous budgetary problems due to exploding healthcare costs and ongoing uncertainties about the financing of social security systems. Support for renewable energies was gradually harmonized across Europe, resulting in the construction of plants in locations where they were likely to produce the highest yield at the lowest cost.

Biomass became a less interesting long-term option for large-scale power generation simply because the biomass available (which initially consisted mainly of waste materials) was used to produce synthetic biofuels for road vehicles. Employed in this way, the existing biomass and systems could generate much higher yields. In addition, the transportation sector – unlike the power sector – had hardly any other means at its disposal for reducing carbon dioxide emissions.

A large number of promising projects, based on entirely new concepts, were piloted around the year 2010. A large tidal turbine farm (underwater windmills) began feeding electricity into the British power grid on a precise schedule. A number of solar thermal power plants – that is, more or less conventional thermal combined-cycle and steam-turbine plants whose heat needs were met either partially or entirely by solar energy – went into operation in Spain. Operating like a magnifying glass, enormous reflective panels concentrate sunlight to heat a gas or a vapor mix that is then channeled into the power plant.

The world's tallest building – a solar chimney power plant – was built in Australia at about the same time. A greenhouse at the foot of the plant's 1,000-meter tower heats ambient air, which then rises like smoke in the chimney to drive large wind turbines. The Australia project demonstrated the feasibility of solar chimney technology. However, construction costs are still quite high and solar chimney plants are less practical in Europe than in sunnier, less-populated regions.

Despite the enormous progress that has been made, photovoltaic systems – or solar cells – that convert sunlight directly into electricity are still not competitive everywhere. Integrated directly into many construction elements (house siding, window panes, roofing materials), they are extensively used nonetheless. In sunny regions, solar cells generate electricity at precisely those periods when buildings require greatest cooling.

System-wide measures to counteract the statistical fluctuations caused by wind and solar power generation were already necessary at an early stage. Today, however, the conventional thermal power stations that are still in operation and customer flexibility provide so many dynamic reserves that the storage of electricity, which is still expensive, is no longer necessary.

■ Power grids

As a result of deregulation, asset management is now the yardstick for grid operation and maintenance. It involves operating plants at their physical limits and optimizing maintenance strategies. Transmission grids have been merged on a continental scale. With the increasing use of renewable energies, long-distance transport is now more important than ever before.

Electricity networks are natural monopolies: The construction of multiple, parallel power grid infrastructures is not economically feasible. Deregulation has separated power grid operators from power generators and electricity traders. While power generators are engaged in cutthroat competition on a national and increasingly international scale, grid operators have no direct competitors. Nevertheless, they have to generate the highest possible profits from the capital tied up in their grids. The use of asset management as a yardstick has dramatically changed the way these grids are operated.

New investments in grid infrastructures are postponed as long as possible. This can be done by selectively operating power grids at their physical limits. Small wireless sensors monitor the temperatures of lines, cables, busbars, transformers and other equipment. Forecasting methods then determine the point in the

grid that can be selectively overloaded for a certain period of time and plan grid operations so that operators can meet the transmission needs of their customers (power generators and traders) to the greatest possible extent with existing plants.

Maintenance costs for individual grid components are based strictly on the damage risk inherent in each component (for example, in the form of penalties to be paid in the event of a blackout). To implement this reliability-focused maintenance approach, the integration of information technology into grid planning, risk management and maintenance management are now standard practice.

By the 1990s, integrated power grids already covered enormous regions – from Portugal to Poland, for example. This was an advantage since it made it possible to share the burdens if a single plant suffered an outage. Following a rapid increase in the amount of power supplied by wind energy – nearly 100 GWs are now installed in Europe alone – international load distribution has become more and more important. The European grid has been gradually expanded around the so-called “Mediterranean Ring” – from Morocco across Libya to Turkey. It is now economical to generate wind power in windy locations in Morocco and transport it to the integrated European grid via cables and lines. Seasonal fluctuations in Morocco and the North Sea are almost ideally balanced out. Regions that generate a great deal of hydroelectric power (such as the Scandinavian countries) are connected by powerful cables to the European grid, where they can deliver short-term capacity, sell excess electricity in very wet years and meet their own needs with deliveries in dry years.

However, the merger of power grids on a continental scale has given rise to entirely new kinds of problems. Rapid load changes in one location (due, for instance, to the failure of a power plant) may cause capacity fluctuations across thousands of kilometers within a period of only a few minutes. This problem has been solved by using power-electronic damping elements known as flexible AC transmission systems (FACTS). The availability of silicon carbon (SiC) as a

new semiconductor material for power-electronic components is an important factor in the success of power electronics in power grids. It is finally possible to design equipment with low electrical heat loss and much cheaper switching technology.

■ Mobile / portable power supplies

Miniaturization and new materials have helped reduce the energy consumed by portable or “grid-independent” devices dramatically. Batteries have nearly doubled in energy density. Fuel cells are used to power portable devices that have to operate for a day or more without a grid connection. Completely new miniaturized systems have been developed to continuously power miniature devices by “harvesting” ambient energy from light, vibrations and temperature differences. In combination, these developments are helping make ubiquitous computing a reality.

Driven primarily by advances in mobile communications and the integration of various media into mobile devices, demand for more compact, portable power supplies has grown dramatically. During the fuel-cell hype at the turn of the millennium, hopes were pinned on miniaturized fuel cells. However, many people overlooked the fact that nanotechnology materials and other innovations could nearly double the capacity of conventional batteries. As a result of these developments, batteries became highly competitive. Portable fuel cells were profitable only in applications where recharging on the power grid is tolerable only after eight or more hours. The vast majority of consumer products do not have to comply with this strict requirement and, thus, are still operated with rechargeable batteries today.

Because not even fuel cells could satisfy the increasing electricity needs of portable devices, developers did everything they could to simply reduce power consumption. The introduction of new display technologies was a giant step forward. Displays based on organic LEDs were already in a position to noticeably lower power consumption, while improving contrast and quality. Manufacturers began to market “electronic paper” displays, which consume electricity only

when changing display images, but not when displaying them in the first place. As a result, devices now consume only one one-thousandth of the electricity of earlier LCD displays. Further miniaturization in the area of semiconductors has also dramatically reduced the energy needed for computing. These two factors – improved battery performance and lower power consumption – have enabled batteries to maintain their leading position in most mass-market applications.

Ongoing miniaturization and integration have made an entirely new type of power supply possible. Many small devices have cut their power consumption so dramatically that ambient energy – including temperature differences between a unit and its environment, movements, mechanical vibrations, recurring pressure loads (for example, in shoes) and, of course, miniaturized versions of highly efficient solar cells – is sufficient to power them. A combination of smart energy management, energy harvesting and battery backup has made ubiquitous computing a reality. All kinds of ordinary objects possess intelligence to at least some extent and can simplify life in many ways (see: Technology Report – Information & Communications).

4.3 Healthcare

Lance Ladic, Dave Rapaport, Lawrence Tarbox, SCR

Most important trends

- **Biotechnology – Diagnosis and Treatment at the Molecular Level**
- **Disease Management – A Shift Toward Preventative Care**
- **Healthcare Management Services – Information Management is the Key to Improved Care**

Abstract

The growing and graying population requires more and increasingly expensive healthcare. Historically, declining health has meant loss of independence and required high maintenance, high cost support from one-on-one interaction with healthcare personnel. A shortage of healthcare workers to handle the growing number of patients suffering from chronic diseases worsens this trend.

Since the turn of the century, biotechnology has had a major impact on the quality of life. A detailed understanding of human genetics and systems biology has significantly improved the diagnosis and treatment of disease. Biotechnology is now regarded as a highly multi-disciplinary science that integrates discoveries in biological science with a wide range of supporting technologies such as micro-electromechanical systems, materials, imaging, sensors (e.g., biochips) and information technology. The pace of development and breakthroughs has accelerated advances in genomics, genetic modification, disease therapy and drug development.

Medical care has undergone a paradigm shift from the traditional hospital setting to the home. Subacute care for many illnesses is provided in the home through electronic monitoring devices that transmit data to health providers in remote locations. Patients remain independent and inpatient costs are reduced.

Inhouse digital personal assistants ensure 24/7 monitoring of the chronically ill and elderly, allowing for increased independent living, ensuring compliance with treatment regimes and yielding timely alerts in the event of an emergency.

Shifting demographics have redefined medical research, treatment and economics. The focus of healthcare in 2020 is on integrative healthcare services, such as totally digitized hospitals that seamlessly integrate intelligent data collected from several disparate sources. In addition, telemedicine is a routine option in the delivery of care anytime and anywhere. New healthcare structures/markets have decision support systems that are integrated, accessible and centralized.

The need for cost savings with improved quality care is driving solutions in information technology, miniaturization and portability, process management techniques (disease, workflow, etc.), communications and networking. Global, high bandwidth networks allow people and machines to communicate from anywhere. This infrastructure allows the four pillars of healthcare – patients, providers, payers and pharmaceutical companies – to interact seamlessly.

■ Biotechnology – Diagnosis and Treatment at the Molecular Level

Trend summary

Advances in technologies such as theranostics, biochips and biosensors, bio-informatics, genetic engineering and pharmacogenomics are important contributors to these remarkable developments in medicine.

Traditional medicine diagnosed disease based on signs and symptoms, applying therapy to modify those symptoms because of the disease's unknown origin. In 2020, doctors are making routine use of a variety of technologies derived through the integration of mathematics, physics, computing, biology and medicine. These technologies capitalize on the building blocks of cells, such as DNA and proteins, enabling physicians to use the molecular basis of disease to devise diagnostic and therapeutic approaches. The combination of analysis and technology provides for rapid customization of therapy to patients, thereby increasing cure rates for diseases.

In the last few decades, advances in molecular biology, in combination with sophisticated biochip-based technologies, has led to the increasingly rapid and inexpensive sequencing of the genomes of patients. Advanced IT infrastructures handle the massive amounts of data that are generated from the large number of genetic tests that are routinely performed. Large-scale databases integrate genomic, proteomic and metabolomic information with other clinically relevant data sets.

Mathematical, statistical and computing methods are applied to biological problems. Sophisticated pattern matching and machine learning algorithms explore the intracellular pathways associated with disease in the highly developed area of systems biology. Armed with this information, pharmaceutical companies are designing new drugs *in silico*, utilizing complex simulations that interface with computer-aided diagnosis and decision-support system software.

One use of genetic engineering that is now commonplace involves the ability to manipulate and reconstitute tissue function. This has tremendous clinical implications and plays an important role in cell and gene therapies. Tissue engineering provides for viable substitutes for failing organs or tissues. It represents the marriage of rapid developments in cellular and molecular biology with materials, chemical and mechanical engineering.

Future trends

Theranostics, the targeted integration of diagnostics and therapeutics, adds value to the drug development process, improves real time treatment of disease and makes treatment cost effective.

A generation of testing has transformed the art of medical diagnosis and treatment to a predictive science. Providers now have tests that match a patient to a therapy and provide feedback about how well a drug is working. Theranostic tests are used to predict and assess drug response in order to enhance the effectiveness of drugs. Molecular diagnostics use genetic information in the detection, diagnosis and prognosis of disease.

Genetic information is used to create customized, patient-specific molecular probes that are targeted toward diagnosis and treatment of specific diseases. These probes target the underlying biomarkers of disease and are used with high speed, high resolution, full body imaging. Collaboration between the pharmaceutical and diagnostic industries has led to many important (and lucrative) new probes being brought to market.

Future trends

Inexpensive, disposable biochips are routinely used in doctors' offices and in the home to monitor gene expression levels and biomarkers that are associated with disease states.

Biochips have matured to the point where they can perform thousands of biological reactions, such as the decoding of genes, in a few seconds. These chips are now used as part of a standard diagnostic protocol during lab tests in hospitals and clinics. Sophisticated lab-on-a-chip designs permit rapid and simultaneous screening of multiple factors in blood and other bodily fluids. Handheld devices that have the capability of reading and analyzing these chips facilitate diagnosis and therapeutic advice at the point-of-care, including the home.

Future trends

In the highly developed field of pharmacogenomics, drugs are personalized to the genotype of the patient and target specific genetic diseases.

How a person responds to a drug is a complex trait that is influenced by many different genes. Doctors can now analyze a patient's genetic profile and prescribe the best available drug therapy at the onset of diagnosis. A person's genetic makeup assists the physician in determining dosages. By accurately forecasting how well a given individual's body processes a specific drug, doctors can now prescribe more appropriate dosages of medicines, decreasing the likelihood of overdose. Furthermore, this detailed understanding of drug metabolism takes the guesswork out of selecting appropriate drugs, lowers prescription costs, speeds recovery time and increases safety, as the likelihood of adverse reactions is eliminated.

The molecular basis of many disease-triggering effects caused by things such as the environment, diet, age and lifestyle have now been determined. This information, together with an individual's genetic makeup, is the key to creating personalized drugs. Knowing one's genetic code now allows an individual to make adequate lifestyle and environmental changes at an early age to avoid or lessen the severity of a predisposed genetic disease. Likewise, advance knowledge of particular disease susceptibility allows doctors to administer careful monitoring of diseases, and treatments can be introduced at the most appropriate stage to maximize the therapy regimen.

Vaccines made of genetically engineered material that is inserted into viruses activate the immune system to fight disease but don't cause infections. These vaccines are inexpensive, stable, easy to store and capable of carrying several strains of modified pathogen at once. Clinical trials for these vaccines (and drugs in general) target specific genetic populations that will respond well to treatment. This shortens the drug discovery process and reduces many of the overhead costs associated with drug development.

■ Disease Management – A Shift Toward Preventative Care

Trend summary

Improved patient care is a direct result of advances in telemedicine/home based care, remote patient monitoring and wearable sensors. Multidisciplinary teams from around the world work together remotely, participating in a patient's care in diagnosis and even surgery.

Since the beginning of the 21st century, healthcare delivery has gradually shifted from outpatient care to home care. Twentieth century home care typically involved periodic visits by a nurse or other caregivers and often required patients to maintain detailed records of various types of data, such as glucose levels and blood pressure. Now in 2020, systems have advanced data collection and remote video communications capabilities that simplify home healthcare by allowing doctors to perform virtual home visits.

Access to healthcare is everywhere – from the home to the workplace to shopping mall health kiosks. A global technology infrastructure has evolved to the point where doctors can easily provide a variety of medical services over large distances. Telemedicine prevents uncomfortable delays, high travel expenses and family separation by bringing specialized medical care directly to the people who need it. It is being practiced in rural areas, school districts, home-health settings, nursing homes, cruise ships and even on NASA space missions.

Networked infrastructures in patients' homes dynamically and continuously monitor biometric sensors that are embedded in clothing. Through broadband networking technology that is now widely available at low cost, physicians conduct online monitoring of patients' vital signs from their offices, outpatient clinics, ambulances or other mobile medical units. This has reduced treatment costs and improved disease management efficiency, while allowing increased autonomy for patients.

Future trends

Continuous monitoring devices measure and transmit data on a patient around-the-clock.

Miniaturized wireless monitors attached to the skin provide valuable information on the physiological condition of patients. This is especially useful for monitoring intensive-care patients in hospitals, high-risk outpatients, babies at risk of suffering sudden infant death syndrome, and police and firefighting personnel in hazardous situations. These devices are mainly passive systems, requiring little interaction from patients. The data captured by these monitors is transmitted to secure web sites where doctors and other healthcare staff can access the patient's entire history when needed.

Wearable computers are more than just simple electronics that are integrated into wristwatches or eyeglasses. They incorporate advanced diagnostic sensors with embedded decision support capabilities that offer real-time feedback. Special clothing incorporates devices that utilize advanced materials such as silicon optical fibers. These devices can sense pressure at various positions in the

body, and measure things such as blood oxygen level, blood pressure, pulse rate, temperature, knee bending during physical rehabilitation and foot pressure distribution. Patients who require monitoring over extensive periods of time wear such devices to aid in their convalescence.

Future trends

Ever-present intelligent personal assistants act semi-autonomously on behalf of patients.

Intelligent small devices off-burden patients recovering from surgery, and accomplish routine support tasks, allowing the person to concentrate on other necessary tasks. For chronically ill patients, these devices provide assistance and integrate customized disease management regimens into their daily routine. A household robot can help lift a disabled person into and out of the bathtub, preventing accidental falls. If necessary, these robots are capable of calling for assistance and communicating vital information in the event of an emergency.

Future trends

Informal and ad hoc processes and relationships have given way to protocols, pathways and contracts.

A significant transformation in healthcare in 2020 is the emphasis on systems approaches to delivering care. Solo practitioners have joined groups, and groups have joined networks. Improved healthcare communications infrastructure has simplified the operation of caregivers stationed at multiple sites. Care and practice with multidisciplinary teams has become increasingly important as the population with chronic conditions has grown, requiring the provision of a mix of services over time and across settings. As teams provide more care, an increasing number of opportunities for multidisciplinary training is offered.

■ Healthcare Management Services – Information Management is the Key to Improved Care

Trend summary

Technology and access to key data in a patient's healthcare record have improved healthcare quality through the reduction of medical errors and streamlining continuity of care as patients shift from one caregiver to another.

Healthcare is one the most information-intensive sectors, and evolves rapidly as new information constantly replaces or adds to old information. The Internet has transformed the way consumers and healthcare professionals find and utilize health information. Sophisticated information technology infrastructures at the national and international levels provide the backbone that connects the four pillars of healthcare: patients, providers, pharmaceutical companies and payers (insurance companies). Integral pieces of these infrastructures include the widespread and low-cost availability of high speed networks, the adoption of international standards for cross-functional and cross-platform data, and the creation of a uniform electronic patient record format. Mobile healthcare now encompasses a wide range of mobile technologies: wireless network infrastructure, mobile devices and mobile applications.

Future trends

Portals provide rapid access to needed information, improving and streamlining care.

Customers, partners and employees are demanding a centralized point of entry to enterprise content and applications in virtually every industry. Security, content currency, content organization, personalization and accessibility are inherent challenges to providing centralized access. Portals simplify healthcare practice through the integration of administrative, communications and research functions, and provide a single span of control to entire healthcare practices. Portals also empower people with the ability to interact with physicians, clinical staff and other experts within a healthcare system. A portal solution leverages existing architecture, data and applications, and seamlessly extends systems to

internal and external stakeholders using Internet and intranet technologies. Access to healthcare information and applications involves a number of unique requirements related to security and accessibility. Bringing the communication between the four pillars of healthcare to a single entry point, portals now provide a secure, reliable point-of-care application.

Patients are placing increasing pressure on physicians, as a substantial number of people regularly conduct their own additional research on conditions and medicines to ensure they get the best possible treatments. Doctors are being asked by patients to prescribe drugs and specific branded treatments that are often unsuitable for the patient's condition. Having information at the point-of-care in an appropriate manner when decisions are being made is a mission-critical factor. Mobile devices store clinical support information such as formularies, guidelines, protocols, journal articles and medical textbooks, health plan information and institutional policies.

Future trends

Universal, secure-access electronic patient records open new opportunities for managing a patient's care.

Just a few years ago, the link between the information underlying patient healthcare and clinical research was largely untapped. Information that could benefit all parties – patients, physicians, investigators, regulators and biopharmaceutical product developers – remained in disparate databases and paper records which were inefficient and error prone. With appropriate standards and tools, record-keeping now utilizes standards-based, technology-enabled, single-source processes that fit the required healthcare workflow. Data that is sent to regulatory agencies has a document-centric view of patients' electronic healthcare records and submissions are formatted using open standards.

The continuous monitoring provided by mobile and home-based information devices generate vast amounts of patient data (from weeks to a few months). Sophisticated algorithms assist caregivers in digesting this information, correlating it with other information in the patient's healthcare record and presenting

concise summarizations with suggested conclusions for consideration. These conclusions are linked to the vast libraries of research so that caregivers can immediately investigate the latest care practices before deciding on the most appropriate course of action.

Healthcare cards store insurance and basic medical data while offering security and privacy. A person's electronic patient record is accessed via this card, giving caregivers up-to-date medical information and insurance plan details. The use of these cards simplifies the eligibility process and expedites medical care. Access to accurate patient information reduces redundant diagnostic testing and decreases the likelihood of prescriptions that could cause harmful drug interactions.

Future trends

Statistical data drawn from patient record archives supports improved standards of care.

In ongoing efforts to control costs, payers (insurance companies) now require doctors to correlate their treatment and diagnosis with research-based, clinical evidence. The practice of evidence-based medicine integrates individual clinical expertise with the best available external clinical evidence. Increased expertise is reflected in many ways, including more effective and efficient diagnosis, and more thoughtful identification and compassionate use of patients' predicaments, rights and preferences when making clinical decisions about their care. Standards of care are derived from statistical outcome measures extracted from electronic patient records, and are used by insurance companies to determine reimbursements.

4.4 Information and Communications, Biometrics

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Most important trends

- **Digital divide**
- **Electronic shopping**
- **Ubiquitous computing**
- **Importance of broadband access**
- **Self-organizing networks**
- **International norms and standards**
- **Automatic translation systems**
- **Knowledge management**
- **Acceptance of new security-enhancing technologies**
- **Biometrics**
- **Breakthrough in quantum computers**

Abstract

Information and communications have penetrated every corner of professional and private life. Intelligent, networked devices are used in homes and offices everywhere. Electronic shopping for goods and services is routine. Broadband Internet access has turned virtual shopping into a form of entertainment. In the business world, mobile Internet access has become a matter of course, enabling people to access workplace data on the road and from home. Skill in using the electronic media has become indispensable for career success. However, not everyone has the same opportunity to acquire it.

Thanks to new technologies, many users can now organize their own networks. Due to global standardization, communications devices operate problem-free everywhere in the world. Automatic translation and voice recognition systems have simplified global communications, enabling people to talk with one other even without a common language. Intelligent knowledge management systems

are driving innovation by making it possible to electronically manage the enormous variety and volume of information now globally available. New types of computers, which can process many times the data volumes of previous systems, have been developed.

Due to today's stricter security requirements, technologies for monitoring public spaces and personal identification are widely accepted. Improved biometric procedures are contributing to better personal security and protection against fraud. Combined with electronic methods, they provide an economical and reliable means of identifying individuals and are used in a wide variety of applications.

■ Digital divide

The ability to use electronic means of communication distinguishes the professional elite from "Internet illiterates."

Future trends

The ability to use and access electronic means of communication distinguishes informed, globally oriented individuals, professionals and educated young people from those with no access to these technologies.

Enormous increases in the volume of information available on the Internet and in the importance of the electronic media in the workplace have created a group of Internet illiterates who cannot keep up with technological developments.

- Although the electronic media has a central role in all school curricula, some young people still have limited ability to use these tools. Like the illiterate, they have great difficulty in finding jobs.
- Older employees who cannot keep up with technological trends are also running into problems, since workplace skills must be continuously updated. Life-long learning is required for success on the job market.
- Such learning begins at school. However, the new elite is proficient in the use of communications tools in ways that go far beyond anything learned in the classroom. A new "electronically educated" class has arisen.

■ Electronic shopping

Online shopping is now a form of interactive entertainment.

Future trends

Consumers routinely shop for goods and services electronically. Electronic payment is as common as the delivery of digital goods. Non-digital products are available for pick-up or can be delivered to the buyer's home.

The spread of broadband technologies and multimedia services has made on-line shopping more attractive. Convenience and additional customer service for intangible and digital products are making electronic commerce an attractive option. Interesting information, previews, interactive virtual video presentations and three-dimensional viewing have turned shopping into a form of entertainment.

- Because they can be ordered more flexibly and interactively and customized to meet individual requirements, intangible goods such as videos, music and services have been among the first items to make the Internet an acceptable shopping medium.
- The eBay auction site, which was the first to successfully combine commerce with entertainment, has been a pioneer in online shopping.
- Increasingly, virtual entertainment is replacing hands-on shopping for tangible goods. Shopping on the Internet is now just as much fun as watching videos. With mobile Internet access so widespread, it is easy to satisfy spontaneous shopping urges. Fashion and home items such as clothing, furniture and jewelry – things that are “supposed to look good” – are the only products still commonly purchased in conventional stores.
- Payment security is no longer a problem. Even bank and credit card service providers offer the option of conducting electronic transactions as a standard service in addition to account management. These service providers also guarantee dealer integrity and make sure that shoppers are identified correctly.

- Although products can be shipped to the buyer's home, they are often picked up at the store. Ever since the rise of online shopping, this has become an important source of retail income.
- **Ubiquitous computing**
Common tasks are getting easier as everyday devices become more intelligent.

Future trends

Intelligent, networked devices for home and office use are now everywhere. We now communicate and use information about the location and status of objects to optimize production and delivery processes and to make life easier.

Since processor and memory capacity have become cheaper and more compact, tiny chips with varying degrees of intelligence are now present in all kinds of objects. Equipped with sensors, they can collect, store and transmit data relating to objects and even establish their location.

- Sensor-based information regarding object location and status is particularly useful in logistics, to transmit the status of a delivery to a customer, for example, or to ensure that the temperature of food does not drop below a certain level on the way to the end-user's refrigerator. Tiny sensor chips also help optimize supply procedures – when refilling beverage vending machines, for example.
- A more intelligent environment means greater convenience. We automatically draw up shopping lists according to personal needs and consumption patterns, since incoming and outgoing goods are recorded right in the kitchen. We order groceries from the supermarket and even pay for them electronically.
- A growing number of robots and intelligent autonomous systems are making everyday tasks easier, from cleaning our homes to the automatic analysis of information such as financial forecasts.
- The desire for greater convenience has to be balanced with the need for privacy, making it important to protect information, especially personal

data, against third-party access. Intelligent environments make some people feel that they are being watched and manipulated (as though living in a fishbowl).

■ Importance of broadband access

Broadband Internet access provides us with continuous access to electronic entertainment and global, virtual corporate networks.

Future trends

Attractive broadband services for businesses and consumers alike are now on the market. These services, which mainly focus on electronic commerce and entertainment, have become an important part of life at home and on the job.

Mobile broadband technology is playing a key role in bringing the Internet into every home and business, spurring rapid growth in electronic entertainment services. It is hard to imagine life without infotainment, video and personal video clips and photos integrated into messages.

- At home, TVs are commonly used to play videos downloaded from the Internet and even to view photos and messages. Home PCs have merged with video consoles.

At work, the Internet is essential. Secure access to corporate networks at the necessary bandwidths enable businesses to share internal data problem-free even outside a company's physical boundaries, giving rise to global, virtual corporate networks.

- Mobile broadband access to the Internet has substantially boosted efficiency, especially among people who frequently travel. Today, mobile terminals are light-weight and portable, thanks to scrolling displays and other features.
- New services and work procedures, such as video-supported remote maintenance and virtual learning with the help of 3D displays, have been developed.

- Electronic communication between business partners, using both video and e-mail, has also continued to grow.
- **Self-organizing networks**
Users now organize their communications networks themselves.

Future trends

Self-organizing networks, in which terminals serve as network nodes and users exchange both data and voice calls from one terminal to another via a third device, are now a reality.

Self-organizing networks are decentralized networks of terminals. Two users communicate by using the equipment of non-participating third parties so that all the terminals within a certain range are linked to form a network. The terminals act as relays to bridge long distances. Particularly in urban areas, this approach is used to generate regional network structures that can be controlled only by the users themselves (as stations in the network). Such networks are helping expand the existing national and international network infrastructures of major communications service providers.

Thanks to their highly efficient and flexible infrastructure, self-organizing networks have proven their worth as regional data transmission and telephony applications. Network nodes can be added, removed and relocated as needed to increase mobility. As a result, they are the most important access networks for global communications channels.

- Since network access is increasingly decentralized, the operators of telecommunications networks have a new role. They no longer service self-organizing access networks. Instead, these are managed free of charge by the users themselves with the help of plug-and-play technology (for example, unlimited phone calls and multimedia messages which can be exchanged between the terminals).
- Self-organizing networks are limited to urban areas and offer only limited quality and security. Inter-regional services such as Internet access are still available from telecommunication service providers. Users who need more

reliable data transmission and telephone service continue to use the network infrastructure provided by telecommunications service providers.

- Where space allows, in-house networks are self-organizing and require minimal maintenance at no cost to flexibility. Although the cost of protecting these networks against unauthorized penetration has increased, gaps in security that used to cause problems have been eliminated.
- Problems due to the uncontrolled use of resources by third parties, which arise when the networks are used as call relays, are also things of the past. Low energy consumption and high battery capacities, coupled with intelligent usage algorithms and high terminal density, have minimized external resource consumption.
- Communications companies continue to administer the basic global communications infrastructure, since self-organizing networks on a global scale are technologically unstable.

■ **International norms and standards**

Global standardization of basic information and communication structures

Future trends

Efforts are underway to establish and harmonize a large number of norms and standards in the communications industry and in conventional technologies on a global basis.

There is interest worldwide in standardizing many basic technologies. Nowhere is this truer than in the communications industry, where high infrastructure costs require extremely accurate planning.

- The development cycles for basic I&C network infrastructures last 10 to 20 years. High development costs have resulted in efforts to harmonize standards worldwide.
- It is unclear if many technologies will succeed on the market. Companies are pursuing innovations to secure better market positions when products

are standardized later on. They are supported by government agencies interested in protecting national interests.

- It is more difficult to standardize products like Internet applications that are cheaper to develop. Here, market leaders, especially, have established a large number of sometimes competing industry standards.

■ Automatic translation systems

People can communicate even when they don't share a common language.

Future trends

Automatic systems are used everywhere to translate even less common languages into English. Simultaneous translation technology exists for many spoken languages.

Improvements in the semantic abilities of electronic translation systems and continuous advances in learning systems that can register and process spoken language have greatly facilitated global communications.

- Electronic communication is no longer a problem, even in languages of limited diffusion, a circumstance that is helping to keep these languages alive.
- Simultaneous translation systems for major languages are now so sophisticated that people who do not share a common language can easily communicate with one other. Because English is no longer a necessary intermediary, it has lost some of its importance as a global language.
- However, cultural misunderstandings and the misinterpretation of implied messages are still a problem, since electronic systems cannot adequately convey such subtleties.
- It is now possible to understand the operating instructions for foreign-made products.

■ Knowledge management

Knowledge management combines high-volume electronic data processing with human teamwork.

Future trends

Although research teams and inventors use knowledge databases to help develop new ideas, human beings still drive the innovative process.

The increasing variety of information, combined with intelligent data analysis systems, has given rise to extensive knowledge databases. Managed electronically, this knowledge is used for innovation within organizations. Teamwork has gained in importance over individual experience and knowledge, which are now part of the knowledge base. Nevertheless, the human component remains indispensable for the innovation process.

- The ability to utilize an organization's knowledge has become a key economic asset. In the information age, only companies that can capitalize on and continuously expand their knowledge (learning organizations) are successful. Electronic systems like workflow management processes, intranets, teamwork portals, communities and creativity techniques based on software tools and visualization are the springboards for this trend.
- Intelligent software systems can evaluate vast amounts of information, recognize patterns and learn. They can make decisions and understand content based on information. However, innovation still requires a certain kind of creativity and analytic ability that machines have not yet mastered. Computers cannot think like people. The combination of human skills, coupled with IT technology, has broadened the innovation horizon.
- Individuals can no longer master the vast volumes of information and knowledge available. Supported by knowledge databases and intelligent electronic data processing systems, teamwork now forms the basis for research and development. The resulting knowledge is extremely valuable in economic terms – particularly when, as in the development of new pharmaceutical products, it is combined with large investments.
- It is now more important than ever to protect knowledge and innovations. Global patents do not always offer protection, since many countries do not

recognize them. Other developments that limit the economic value of innovations include the migration of entire teams of experts and the general availability of knowledge on the Internet.

■ **Acceptance of new security-enhancing technologies**

New surveillance and personal identification technologies satisfy the need for personal security.

Future trends

Security is such a dominant concern that people are now willing to accept new surveillance and personal identification technologies.

The increasing globalization of everyday life has made the need for personal security even more important. Video surveillance of public spaces and buildings is now commonplace and personal data are used for monitoring people's whereabouts, limiting anonymity both on the road and at home.

- Surveillance and personal identification technologies as well as systems that can detect patterns in data have become commonplace in public areas. They are also commonly used in the private sphere to safeguard homes and property. Evidence provided by such technologies is now frequently used in court cases.
- Without these technologies, border surveillance would no longer be possible, since not only travel but also global crime and terrorism have increased.
- Data protection is also subject to stricter standards. We have to have a reliable means of protecting both corporate and personal data against third party access, even during transmission. Global data and the communications infrastructure also have to be protected, since failure could have serious economic consequences.

- People require a high level of security in the private sphere to compensate for highly flexible and insecure working environments. As a result, they are willing to surrender a certain amount of personal freedom and voluntarily provide access to data on their current whereabouts and past activities.

■ Biometrics

Combining biometric methods is making identification more reliable.

Future trends

Biometric processes for automatically identifying people have become indispensable. They are supplementing well-established methods and greatly limiting opportunities for fraud.

Biometrics is the measurement of the biological features that are unique to a person: fingerprints, eye structure, voice prints, handwriting and even the pattern of veins on the surface of the hand. Measuring these features helps verify a person's identity by comparing the measurement to a sample provided ahead of time. The goal is to maximize reliability and minimize ambiguity quickly, easily and economically.

- For a long time, people resisted the measurement of features like the iris on the grounds that it could cause physical injury or constituted an invasion of their privacy. Such concerns are slowly disappearing. Due to an increasing desire for security, people have become used to biometrics.
- Quick and easy procedures such as fingerprinting have also become very reliable. Combined with established electronic methods such as PIN input, the rate of identification and protection against falsification is now relatively high. The ease with which the method can be used – only one initial registration is needed for biometrics – is a major advantage.
- Fingerprinting and iris measurements are now well-established supplements to personal IDs in public life. Because they are cheap and easy to use, biometric methods are also well-established means of verifying the identities of individuals authorized to access secure data and secure areas.

- Miniaturized biometric systems make it difficult for third parties to steal or use personal devices such as smart phones, notebooks, bags and jackets. Many vehicles are protected by simple scanners.
- Biometrics are indispensable in surveillance – in monitoring working hours, for example. Finger scanners have replaced the conventional time clock.
- **Breakthrough in quantum computers**
Quantum computers offer unlimited computing power.

Future trends

Quantum computers, which now offer nearly unlimited computing power, are paving the way for entirely new computer applications. Parallel computing is now a matter of course.

Quantum computers, which can simultaneously incorporate a large number of bits (known as “qubits”) into a single information unit and process them, are far more powerful than binary processors. However, the technological complexity of quantum computers makes them difficult to use, since quantum phenomena occur only at the atomic level and involve very small differences in energy.

- To encrypt data, many high-security electronic applications rely on the principles of quantum physics. They exploit the fact that quantum states are intertwined and change through measurement, so that data monitoring does not go unnoticed. These technologies were used initially by governments to transmit sensitive military data, for example.
- Due to the highly parallel nature of their computation algorithms, quantum computers are ideal for processing enormous volumes of data. That is why they are frequently used in biochemical research – to perform genetic or molecular analyses, for example. However, they can also tackle entirely new problems that are beyond the capabilities of binary computers.
- Quantum phenomena occur at atomic levels. In terms of energy, quantum states differ only slightly from one another. As a result, maximum precision at the atomic level is required to control and measure them. We can do this, for example, by measuring magnetic fields in the way that nuclear

magnetic resonance measurements are made by imaging devices or by taking measurements at extremely low temperatures in a vacuum. Quantum computers are not yet used on a wide scale because of their technological complexity and cost.

4.5 Materials and Nanotechnology

Rainer Nies, Siemens Corporate Technology, Erlangen

Most important trends

- **Materials tailoring**
- **Use of ecological materials**
- **Computational materials science**
- **Nanotechnology / Nanomaterials**
- **Bioengineering**
- **Adaptive structures using intelligent materials**

Abstract

Knowledge in the field of materials science has increased exponentially over the last few decades. As a result, we can now tailor multifunctional materials to meet specific needs. With computer-aided modeling, one of the most powerful tools at our disposal, we can also base simulations of the properties of complex structures on the atomic structure of matter.

New, innovative materials are making a major contribution to the creation of a sustainable balance between the economy and nature – by reducing pollutants, curtailing materials consumption and, indirectly, cutting CO₂ emissions, for example. Nanotechnology, which utilizes new effects to generate a large number of new and improved products, is one of the key technologies of our century. Nanotechnology's outstanding economic significance derives from its extensive leverage effects in the areas of product functionality and customer benefit. Bio-engineering uses biological materials, concepts and processes to provide revolutionary solutions in technology and healthcare. Intelligent materials – and the adaptionics based on them – are making new and innovative applications possible through the integration of sensors and actuators into composite materials.

■ Materials tailoring

Future trends

Knowledge in the field of materials science has increased exponentially over the last few decades. As a result, we can now tailor multifunctional materials to meet specific needs.

In the middle of the twentieth century, materials development was still largely an empirical discipline. Called “materials engineering,” it focused primarily on optimizing a limited range of standard materials through trial and error, a relatively time-consuming process. The scientific knowledge of materials began to expand considerably only at the end of the twentieth century. Now called “materials science,” the study of materials has become a sophisticated field of scientific inquiry. As a result, our materials capabilities are now greater than ever before. New methods of materials tailoring are enabling us to customize materials to meet precisely defined requirements. We first specify a product’s properties on the basis of its desired functionality and then synthesize the materials required to manufacture it. Performance, cost-effectiveness and customer acceptance of industrial products depend to a large extent on the particular materials used.

However, ever-greater cost pressures and ever-shorter innovation cycles have given rise not only to new materials but also to much more effective methods of materials development. These methods are based on a comprehensive knowledge of matter’s structural and functional properties, coupled with new experimental procedures such as highly sophisticated forms of large-scale and automated parallel experiments. For example, pipette robots, now in widespread use, originated in materials research conducted by the pharmaceuticals industry. But it is the high-performance, computer-aided simulation tools used in so-called “computational materials science” that have made the greatest contribution (see page 213).

This revolution in materials development has placed new demands on development teams, which are now interdisciplinary units comprising materials scientists, physicists, chemists, engineers, computer engineers and biologists.

The intensification of development activities has benefited users by greatly increasing the variety and significance of customer-specific as compared to standard materials.

Exponential increases in performance, particularly in the area of information and communications technology, reflect recent progress in materials science in a very impressive way. For the last 50 years or so, transistor density, processor performance, communication bandwidths and storage density have all doubled every 18 to 24 months. The first development – the extraordinary rate of increase in transistor density – is generally known as “Moore’s law.”

The use of functional materials and multifunctional materials, which bundle a large number of system-optimized properties, is now widespread. When it is not possible to produce a homogeneous material with all of the properties required for a particular application, composite materials are frequently the solution. In such cases, the properties of individual material components complement one another – as in fiber- and particle-strengthened materials.

Important progress has also been made in materials intended for use under extreme conditions. Advanced high-temperature materials have led to continuous improvements in the efficiency of fossil-fuel power plants. Lightweight construction materials coupled with innovative approaches have substantially reduced the weight of airplanes and cars. Who, at the turn of the century, would have been willing to travel in a plane whose fuselage consisted primarily of plastic parts that had been glued together? Today, this type of construction is state-of-the-art. Of course, for highly stressed components, new metallic materials like nano-structured films are also used. With half the weight, these materials provide twice as much resistance to bending. To produce them, all you have to do is leave out half the atoms – just make sure it’s the right half.

■ Use of ecological materials

Future trends

Modern materials are also making a major contribution to the creation of a sustainable balance between the economy and nature. Their impact is evident chiefly in four areas – pollutant reduction, lower materials consumption, the use of renewable materials and, indirectly, the reduction of CO₂ emissions.

Over the last few decades, government regulation has made a vital contribution to the progressive reduction of pollutants and the damages they cause. Used-car guidelines, electronic waste regulations and other requirements – all ground-breaking developments in their day – forced the introduction of substitute materials that have a lower negative impact on nature and people. However, because product prices rather than environmental compatibility are still the main consideration of today's consumer and because natural material flows ignore national boundaries, work is continuing on follow-up regulations with global application.

Curbs on materials consumption in industrial countries have only made significant gains in the last two decades. At the turn of the century, product refurbishment and the “equivalent to new” seal of quality were still considered innovative concepts. At the same time, recycling of non-durable goods like packaging was extended to apply to more complex consumer goods. This, in turn, required a redesign of products ranging from mobile phones to investment goods such as light rail systems, so that their subsequent dismantling and re-use could already be taken into consideration during installation. Pure materials recycling and the refurbishment of used components were applied in the process. Contrary to the expectations of many skeptics, a closed materials loop encompassing the reuse of materials and components has been shown to yield economic advantages.

Modern high-performance materials also play a decisive role in the reduction of CO₂ emissions. Light construction materials are making it possible to significantly reduce the weight of automobiles and so make them more economical, while high-temperature materials are a key to efficient fossil-fuel power genera-

tion. The cost-effectiveness of regenerative power supplies like wind and solar energy is likewise largely dependent on the materials used in their production. Over the last decade, renewable materials have been used with increasing success. Through their application in niche products, materials like biopolymers, which are based on vegetable oil derivatives and strengthened with natural fibers, have now become economically feasible. Biopolymers are used on a large scale in automobile manufacturing, for example, to replace conventional plastic components like door linings and dashboards. They are also frequently employed in “low-tech” products like plastic bags and other forms of packaging because, since the carbon dioxide released in their combustion has been previously withdrawn from the atmosphere, they can be composted or burned without increasing net CO₂ levels.

Despite considerable progress, worldwide materials consumption remains at alarming levels. In the last 25 years alone, industrial processes worldwide have consumed more natural materials than in the rest of human history put together. The creation of a sustainable balance between the economy and nature is one of the major challenges facing our century.

■ Computational materials science

Future trends

Computer-aided modeling, which enables engineers to simulate the properties of complex structures on the basis of the atomic structure of matter, is one of the most powerful tools of materials development.

Computer simulation has been one of the fastest growing fields of materials science and chemistry over the last 25 years.

Simulation programs like the “finite elements method” were the first stage. These programs enabled engineers to simulate the functioning of larger components. However, to calculate a component’s mechanical or thermal behavior, advance experimental determination of the properties of individual materials was still necessary.

At the turn of the century, so-called “atomistic simulations” became increasingly important. These made it possible to predict the properties of new materials on the basis of fundamental physical laws like the principles of quantum mechanics. Simulations could be used to investigate optical, electrical and mechanical functionalities as well as mechanical and thermal properties. The next major challenge was to combine both methods to construct a single simulation tool. New models for material microstructures and recently available increases in computing power have made it possible to consider real materials with all their defects, impurities and grain boundaries on a realistic basis. As a result, there is now an enormous potential for increasing efficiency in the development of customized materials. The main applications for this so-called “computational materials science” include the prediction of new functional materials, the pre-selection of possible candidates for subsequent experimental investigation, the design of materials for use under extreme conditions and the optimization of complex materials systems.

■ Nanotechnology / Nanomaterials

Future trends

Nanotechnology, which utilizes new effects to generate a large number of new and improved products, is one of the key technologies of our century.

Over the last two decades, nanotechnology has fully justified its claim to be much more than just a further step in miniaturization. Its economic significance is not due to its value as a stand-alone product, but rather to the major improvements in product functionality and customer value that it makes possible. Nanotechnology normally accounts for only a small part of production costs. However, its inclusion is often the reason a product is innovative to begin with. Today, most manufacturing involves nanotechnology either as a product component or as a factor in production processes.

“Nanotechnology” means the use of effects and processes relying on devices that are only a few nanometers in size – typically, from a few tens of nanometers down to the atomic level of 0.1 nanometers. Changes in basic physics on

the nanoscale yield new effects. Quantum phenomena like the tunnel effect replace those described by the principles of classical continuum physics such as Ohm's Law. Particles, fibers, super-thin layers, lateral nanostructures and functional modules – which are integrated, for example, into materials, coatings, components and complete nanosystems – are the most important elements of nanotechnology.

There are three main areas of application: nanoelectronics, nanobiotechnology and nanomaterials. Overlapping is common. Sensors, for example, employ a large number of technologies. This report focuses primarily on nanomaterials (nanoelectronics and nanobiotechnology are discussed elsewhere).

Nanoparticles, which permit the integration of new functionalities into conventional materials, are the most important components of nanomaterials. They are particularly suitable for use as fillers for polymers, making these more stable, wear-resistant and heat-proof. Nanoparticles are also smaller than the wavelength of visible light and, thus, invisible. Today, polymers strengthened with nanoparticles are widely used in the housings of light-emitting diodes, which have completely replaced light bulbs in cars and are a key design element in room illumination.

So-called “carbon nanotubes” are good examples of nanofibers. These tubes, made of carbon and only a few nanometers thick, are now manufactured industrially and at prices that allow large-scale commercial application. Carbon nanotubes have astonishing properties: depending on their structure, they can function as semiconductors like silicone or conduct electricity a thousand times more efficiently than copper. Nanotubes conduct heat twice as efficiently as diamonds, the best heat conductors, and have 20 times the tensile strength of steel. Integrated into composite materials, they make it possible to produce new high-performance materials with both mechanical and electrical applications. Carbon nanotubes are also essential components in today's supermarket scanners. As an admixture to conductive polymers, they are a key element in electronic price tags that can be read automatically.

Nanoparticle coatings, which provide new functionalities, have now replaced earlier types of covering. They are easy to clean and, due to their high resistance to dirt collection, have considerably reduced the time and expense of household and industrial cleaning. Nanoparticle coatings have also replaced ecologically dubious anticorrosive coatings.

Lightweight construction is another area in which nanotechnology is helping the environment. The integration of nanoparticles and the use of tailored nanostructures like nanofilms have continuously increased the mechanical properties of polymers and metals. This, in turn, has led to major reductions in weight and, hence, consumption, particularly in the field of airplane construction.

Contrary to fears voiced at the turn of the century, at least one horror scenario has not been realized. For the foreseeable future, self-reproducing nanorobots capable of threatening human life will continue to belong solely to the realm of science fiction.

■ Bioengineering

Future trends

Taking nature as our model, we use biological materials, concepts and processes to develop revolutionary solutions in technology and healthcare.

Nature has been optimizing materials through millions of years of evolutionary development – a fact that human beings have always exploited. Mankind used to be wholly dependent on natural materials like wood, fiber and animal skins that could be reworked for human purposes.

We have now developed these early forms of bioengineering to the point that their results often surpass the technical solutions typical of the twentieth century to make new applications possible for the first time. We use biological materials, processes and concepts on a large scale in medical diagnostics and therapies, in the manufacture of materials for technical purposes and in bio-molecular production processes.

Today, modifications of biological materials – for example, conventional processes like leather tanning and charcoal production – are called “biomimetics.” The conversion of wood and plant fibers into ceramics has now become a highly specialized process for manufacturing bodies with a unique hierarchical pore structure for a variety of different applications in modern catalytic converters and filters. In a process similar to that used to produce charcoal, a piece of wood or even a rolled-up piece of corrugated paper is heated in a receptacle without oxygen until only the carbon structure remains. Liquid or gaseous silicon, which binds with the carbon to form extremely hard silicon carbide, is then allowed to flow into the receptacle. The original cell structure remains intact so that a kind of fossilized copy of the so-called “biotemplate” remains.

Biomimetics also includes the replication of natural materials. The strength of artificial spider silk far surpasses that of all known petroleum-derived polymers. Unknown to most users, this material is employed in tear-proof high-tech materials and ropes. It is also a key component of robust, absorbable surgical sutures. The pre-products for biomimetic spider silk are produced economically in bio-reactors, as are many other materials like anti-smear and antifreeze ingredients. Solid bodies can also be manufactured in these biological factories. As everyone knows, cells are able to generate bones, shells and teeth. And now we can use the same bio-mineralization process to produce synthetic ceramics and to cover artificial materials with protective layers and periodic inorganic structures at room temperature.

We can also synthesize natural substances by biological means. Using so-called “tissue engineering,” we can grow materials like artificial skin and liver tissue in special reactors. These materials are used as artificial implants in new types of medical treatments. It has long been possible to design the surface of synthetic materials to assure the biocompatibility and longevity of a wide variety of prostheses like artificial joints and bones. “Neuroprosthetics,” the linking of conventional electronics with the nervous system, is only the latest development in this field. For the last few years, it has also been possible to construct artificial hearing systems. In some cases, sight can also be restored through the use of artificial retinas.

Biosensors, which are used in a wide variety of applications, exploit the symbiosis of biomolecules and electronics. In biosensor devices, biomolecules like proteins and DNA sequences, which interact with other molecules on the key-lock principle, are fixed on a chip. The reaction can then be read out instantaneously by electronic means to identify infection-induced antibodies in the blood, for example. The widespread use of these portable and easy-to-use devices over the last few years has made a significant contribution to cutting healthcare costs. It has also considerably improved the quality of many types of diagnosis. By enabling comprehensive health monitoring, these multifaceted and relatively inexpensive devices also facilitate the early recognition of many types of diseases for the first time. Tumor diagnosis, the development of pharmaceutical substances and individualized medications, and predisposition diagnostics for recognizing hereditary diseases are only the most prominent examples. Non-medical applications have also become widespread. Foodstuff analysis has been greatly simplified, and the comprehensive monitoring of water quality, for example, is now possible. Biosensor technology has even penetrated the field of identification systems, where biological earmarks are being used to provide proof of origin. (Information bionics – the use of biomolecules as calculating machines – is described in the IT Technology Report.)

■ Adaptive structures with intelligent materials

Future trends

Adaptronics, which is the logical sequel to mechatronics, integrates sensors and actuators into composite materials.

Taking a cue from nature, materials systems which use processes like status monitoring to anticipate breakdowns, repair themselves and adapt their properties to suit their surroundings have been developed. Sensors and actuators, which are controlled by an internal or external regulator, are integrated into these materials to form so-called “adaptive structures.” “Adaptronics,” the name for the entire field, is formed from the words “adaptation” and “electronics.” So-called “smart materials,” which have the ability to change their properties in response to external influences, provide the basis for adaptronic systems.

Piezo-materials are among the most prominent examples of such materials. They can convert electrical energy into mechanical energy or the other way around. These materials change their length when voltage is applied to them, and they emit an electrical charge if they experience deformation. As a result, piezo-materials are perfect sensors and perfect actuators in one. Their advantages as actuators have been known for a long time. At the turn of the century, piezo materials made a major contribution to reducing fuel consumption in cars by revolutionizing the injection systems of internal combustion engines. But while internal combustion engines are going out of style, piezo materials are not: as sensors and actuators for active noise and vibration absorption, they are more in demand than ever. Mats of composite adaptronic materials, which contain a large number of thin piezo fibers, are now installed in the roofs of luxury class automobiles. Electronic signals cause these fibers to vibrate in a controlled fashion in order to dampen specific unpleasant noises.

Lightweight components in airplanes are outfitted in a similar way. Integrated piezo elements pick up aircraft vibrations immediately. Then, using piezo fibers as actuators, a closed loop control acts to dampen the vibrations. As a result, the components affected are subjected to less overall strain and can, accordingly, be constructed of lighter materials. This, in turn, helps conserve resources by reducing overall materials consumption. But not only ceramics exhibit piezo-electrical properties. Synthetic materials can have them, too. Due to their extreme sensitivity to pressure, thin piezo films give the surfaces of household robots the sensitivity of the human skin.

Shape memory alloys – metals that return to their original shape when heated above a certain temperature by an electrical current, for example – are another important type of adaptronics. Concealed glasses frames that revert to their original forms when submerged in a warm-water bath are now commonplace, while car fenders that can be straightened with a hairdryer have only recently become popular in up-market sports vehicles.

In the form of wires and feathers, shape memory alloys also have a wide range of applications as actuators. They have long been used as locking elements in window lift motors, as valve controls and in car headlights, which they guide around curves as soon as the steering wheel is turned. Such actuators are now employed as reinforcing fibers in adaptronic structures as well – many filigree structures would not be possible without them. For example, if an earthquake causes the steel frame of a 1,000 meter-high skyscraper to start vibrating, these actuators will generate an appropriate sensor-guided counter pressure to prevent the building from collapsing. The window fronts of these high-rise buildings consist, of course, of electro-chrome panes that allow light and heat radiation to pass in accordance with weather conditions. This, too, helps optimize energy management in modern buildings.

Self-healing materials contain, for example, hollow fibers or capsules filled with chemical substances. The multi-functional mobile communicator that you accidentally dropped from a second story window is no longer a write-off. The cracks produced in its plastic housing and ceramic components break open thousands of hollow microscopic bodies. These, in turn, release a chemical reagent that reseals the damaged parts. This functionality, which is equivalent to a materials immune system par excellence, increases tolerances in many products.

4.6 Transportation

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Most important trends

- **Reliability is creating a new kind of proximity.**
- **Networked vehicles are enhancing safety.**
- **Distributed traffic management**
- **Personalized transportation**
- **Software-based drives control and safety enhancement**
- **A wide range of new drives technologies is reducing fuel consumption and harmful emissions.**

Abstract

Advanced I&C technologies are helping achieve the long-desired goal of fully networked transportation modalities. This development, in turn, is enabling each individual type of transportation to realize its particular advantages. Transfers are easier for travelers, and systems can take into account recent developments such as disturbances in traffic flow and sudden schedule changes, since personal assistance systems are always online and capable of accessing all necessary sources of information.

Because payment is cashless, many car owners have switched to public transportation.

In addition, the availability of tried and tested event management support and fully automated decision-making has made the long-distance transportation infrastructure much better at rerouting traffic on congested city streets and highways and in high-traffic public transportation corridors. Centralized systems have not improved, however, because many of their functions have been assumed by decentralized vehicular and infrastructure systems.

Because the new systems can learn and store user preferences, driver and traveler acceptance has also risen sharply, making it easier to implement rerouting strategies.

As its development becomes easier, faster and more reliable, software is being employed in more and more safety functions and undergoing more frequent learning cycles. This is being facilitated by the fact that it can also be installed in existing vehicle types. As a result, transportation has become safer for everyone involved, despite ever-increasing traffic density.

Upgradeability and further improvements in engine controllers are making it possible to comply with ever-stricter emission standards without having to cut traffic volumes substantially. The success of viable alternative drives is also helping cars meet these requirements.

■ Reliability is creating a new kind of proximity

Innovative technologies are bringing China and Europe closer together.

Future trends

In addition to the Trans-Siberian Railway, there is now a safe and fast Eurasian railroad linking Europe and China. With one of the world's most advanced transport infrastructures, China has become a crossroads for all of Southeast Asia due to the implementation of advanced logistics technologies.

Shipping:

The small boats that used to travel up the Yangtze to Chongqing have been replaced by sea-going container ships with 10,000 G.R.T capacity. The Three Gorges Dam, having overcome initial bottlenecks at its sluices, has proven itself an efficient transportation route. Located around 600 km upstream, Chongqing is now one of the main crossroads of Southeast Asia. Goods shipped from Chongqing can reach all the countries of Indochina as well as Burma and India within four hours. Traffic also flows in the opposite direction to Central China, the Chinese coast and Europe.

Railways:

The final section of the Trans-Eurasian Railway between Ürümqi and Alma Ata was completed a few years ago. Thanks to a high degree of railway automation, it takes less than four days to travel the 6,000 kilometers from Central Europe to Chongqing. Most freight is transported by driverless systems. In the past, there were problems implementing the project because Europeans felt that the risks outweighed the benefits. However, highly reliable logistics processes have won over the last remaining skeptics. Logistics event management and modern cargo containers liberally equipped with sensors are standard, which means that the promised transport quality – that is, compliance with schedules and physical specifications – is much more reliable. Problems on long routes no longer mean long delays, since alternate strategies have been planned in advance and even generated automatically. In an emergency, less-urgent deliveries can also be re-routed – and costs remain transparent. Today, China is Europe's most important and most reliable trading partner.

Road infrastructure:

Cultural differences have also been quickly overcome. Chongqing has developed from a provincial town into a cosmopolitan metropolis. A large number of international shops and restaurants are helping shape the city's image. Inner-city traffic is as much a problem here as it is in European cities. In fact, Chongqing's advanced traffic planning and control systems as well as its infrastructure-based collision avoidance systems have all been provided by leading European suppliers.

■ **Networked vehicles are enhancing safety.**

Traffic telematics are improving availability, safety and convenience.

Future trends

All electronic components in today's vehicles have been reliably networked to produce powerful assistance systems – many with external communications capabilities.

Shipping:

In the past, ships were forced to rely on external assistance during high-sea emergencies. Now, however, new network-based services are providing a measure of self-reliance. For example, engine problems are communicated to a maintenance call center via mobile equipment carried by the ship's crew. Goggles or a face shield combined with a mobile computer and equipped with a mini-camera and a projector, which can display data and images at eye level and superimpose these on a real situation, are only the visible components of augmented reality technology. A small radio LAN antenna is connected to the ship's internal communications system, which transmits information anywhere in the world. The ship's mechanic not only detects faults, but also receives repair instructions from experts or an automated system. Depending on the configuration, information is either provided in voice form or transmitted to the goggles from the maintenance center. The data can be in the form of programming parameters, exploded drawings or moving images that show, for example, the mechanical steps to be carried out and the order in which they should be performed.

Road traffic:

Networked telematic systems provide drivers with continuously up-to-the-minute information on congestion and road signs, which are displayed on board. Sensors, combined with automatic situation analyses and automatic communication between vehicles, warn drivers of hidden dangers. Stationary or on-board sensors can warn all the drivers in a specific area of a motorcycle approaching too quickly from a side street or of a traffic jam just around the corner.

■ Distributed traffic management

In 2020, traffic management systems allow vehicles to communicate with each other.

Future trends

The development of self-organizing and continuously self-changing networks with the help of computer-to-computer communication has spurred the development of distributed management strategies, making it possible to link compact traffic management systems with extensive conventional network control systems.

The decentralization of traffic and logistics management practices is now standard.

Advances in the processing speeds of optical computers and the unprecedented storage capacities of fast-access quantum memories, combined with new software technologies, have broadened the horizons for traffic management systems. For example, neural computing is particularly appropriate for adaptive systems and forecasting tools. These developments are used to combine vehicle self-organization with the specified strategies of traffic and urban planners in continuously self-changing radio networks. Individual mobility is intelligently distributed to different transport modalities like road, rail, water and air. Courier, express and package (CEP) services pick up and deliver goods in a more spontaneous and individualized manner, since software agents with negotiating capabilities can rapidly accept or modify orders.

This, in turn, is making ever-increasing, personalized and economically imperative mobility more cost-effective and economical, while enhancing the safety of everyone involved.

The trend began with distance assistance systems in passenger cars that can communicate with neighboring automobiles, reducing system response times and minimum inter-car distances. Many activities – from merging with highway traffic and passing other cars at night, even in the rain or at high speeds on the German Autobahns – have become safer and less stressful.

Individualized and secure sub-networks manage truck fleets, for example. They also register vehicle emissions in real time and keep these within pre-set limits through standard settings (even for entire fleets). These networks transmit confidential diagnostic data to the service center and initiate any remote maintenance work that may be needed. This data includes automatic reports telling the engine control (and the driver) not to exceed certain engine speeds as well as instructions for necessary repairs.

Peer-to-peer communication, in which on-board computers communicate with each other, and multi-hop connections from one vehicle to another allow information to be passed on to more remote drivers affected by a given situation. On the increasingly common rotary roads, or even at normal intersections, vehicles communicate their direction of travel to other road users so that they can join rotary traffic quickly and safely. This, in turn, increases throughput at successive intersections.

By transferring these technologies to cities and integrating traffic lights into communications and ad-hoc networks, it is possible to selectively control priorities and, thus, combine an overall traffic strategy, the right-of-way for public transportation and emergency vehicles, and an allowance for individual behavior (children won't wait at a traffic light for five minutes) within a single system.

Supplemented by traffic data collected through economical methods such as aerial radar surveillance, "floating car data" from vehicles is compressed and transmitted to traffic management centers. This data includes information from all other available sources such as intersection computers and their sensors, camera surveillance systems with situation analysis (congestion, accidents, vehicles traveling in the wrong direction) as well as event management systems that forecast major events and their effects. A traffic diversion strategy that fits the immediate situation is then determined on this basis and communicated to vehicle systems so that they can take traffic conditions into account.

In 2000, when the German railway system separated freight lines from passenger service on the basis of the “Network 21” strategy, distributed management systems began making inroads into the field of freight transport as well. Because most freight moving on main railway lines is transported through a mixture of driverless cargo movers – railway vehicles the size of a truck – and long high-speed trains, it is necessary to take into account varying speeds while maintaining maximum track occupancy. Adapted block spacing and lengths as well as central management systems permit a powerful combination of 700-meter-long freight trains and cargo movers that carry one or two containers. On branch lines and rail spurs to loading points, cargo movers and elements such as points, track sections and railway crossings are integrated into a communications network and decide among themselves which goods travel where. Perishable goods always have first priority, of course. This technology has been extensively tested on closed industrial and harbor railway lines. High-tech cargo handling systems enable long trains to be put together in record time for the overnight trip from Hamburg to Milan.

Central management systems continue to predominate on the expanded and Europe-wide main high-speed railway lines with either conventional or magnetic levitation technology. However, interfaces to distributed systems are available at the junctions, providing reliable connections to all kinds of public transportation.

The integration of standard communication terminals for pedestrians and bicyclists is increasing convenience for this user group as well.

■ Personalized transportation

Personalized mass transit and new approaches to traffic management

Future trends

The networking of all road users through personal communication terminals like personal digital assistants and information kiosks – that is, network access points that are accessible to the public – have made it possible to generate up-to-the-minute traffic information and distribute it individually. In urban

areas, the difference between public and private transportation is disappearing. Smaller vehicles and automation systems are shortening routes and personalizing departure times.

In densely populated areas, public transportation is turning into public-private transportation. A number of individual steps, made possible by I&C technologies, have given rise to a new understanding of transportation, one which is blurring the distinction in urban areas between private transportation – usually in passenger cars – and public transportation on buses and trains. Inspired by this trend, the industry has developed suitable vehicle concepts for small passenger groups, taking a cue from ski lift manufacturers.

- Whether you drive your own car, share a car with others, take a rail taxi or a people mover between shopping centers or across the college campus, departure times and schedules are no longer important. Thanks to individually tailored information, available from a personal travel assistant or at a variety of information kiosks in and outside vehicles, every passenger has his or her own individual schedule or route planner, regardless of the time of day, traffic conditions or the weather. Smaller, driverless vehicle units, which are available at bus and train stops, customize routes more easily than large buses and trams that seat 80 to 100 passengers. Distributed control makes these systems less susceptible to errors than a centralized system.
- Ticketing, which used to be a headache for the occasional user, is no longer a problem. Electronic ticketing via a variety of media, such as mobile phones, memory chip cards and prepaid cards for the cautious, satisfies everyone – even die-hard car drivers – by providing best-price options.
- Personalized traffic information is available right in the car. Utilizing traffic forecasts for the planned route and individual preferences stored in a personal profile, the system generates information on an individualized basis. It also ensures that not all vehicles are directed toward the same alternate routes – which would very quickly produce congestion there, too. Based on individual driving patterns and by following suggestions, the systems learn new things and take these into account in making further recommendations. They also plan alternate routes in advance in order to take

account of sudden disturbances or change requests, so that decisions can be retrieved in a flash, when transferring from a car to the bus or subway, for example.

- In rural areas, too, I&C technologies have developed the bus-on-demand service concept further than anyone thought possible after the failed experiments of the 1990s. Provided by bus companies and car owners willing to share rides for a fee under clearly defined conditions, this type of service meets the special requirements of less densely populated areas. Requests for such transport-on-demand services are forwarded to service providers by agent technologies. In addition to regularly scheduled basic service, this allows companies to reliably offer occasional supplementary rides and also maintain lines without spending a lot of time or money. This option attracts additional customers for these means of transportation and helps operators cut costs.
- **Software-based drives control and safety enhancement**
Software is improving mileage and safety.

Future trends

Not only is the importance of software increasing compared to that of other vehicle components, it is also the yardstick by which mileage, fuel consumption and comfort are measured.

Engine control software:

Engine control software updates have improved performance by as much as 5%, while lowering fuel consumption and substantially minimizing noise. Operators install the software themselves by buying it on data media from logistics companies or by downloading it directly from the vehicle manufacturer's Web site. Of course, operators can also leave it up to the shop mechanic. As a result, enhancements that used to be available only with a new vehicle generation can be obtained simply by installing updates in a large portion of a vehicle fleet.

IP-based bus systems:

Cars are completely digitized. The latest Web technology is a standard feature of every vehicle. The main thing here is not the link to external systems, but net-

works within the vehicle itself. The hierarchical bus systems needed to guarantee security, which come with firewalls between the security and comfort features, have greatly improved all vehicle functions. These buses link all intelligent systems, making it possible to generate new functions such as 5th generation brake assistants that collect preliminary information on potential emergency braking situations from all available sources. This unburdens drivers in both normal and dangerous situations and substantially increases traffic safety. Computing power is also bundled for a wide range of applications that perform telematic and other functions, unless other requirements are imposed.

Reliable software:

Software systems embedded in vehicles are traditionally complex in their relationships to each other and the world outside. Early in this century, this high complexity led to misunderstandings and sometimes to serious problems. Take the first adaptive cruise control (ACC) system, for instance. This system automatically controlled the distance between vehicles by regulating speed and even intervening in the brake system. This was done by measuring the speed of vehicles in front of the user's own car with radar technology. These systems suffered from serious data flow problems, resulting from a lack of experience in the use of this technology at the time. As a result, the systems were not practical for every road situation. Today, however, software readiness for producing these systems is no longer a dream. Software engineering methods like fault tree analysis and failure mode and effects analysis (FMEA) are standard practices, guaranteeing reliable software systems in vehicles.

■ **A wide range of new drives technologies is reducing fuel consumption and harmful emissions.**

Changes in driving technology

Future trends

Electric engines and fuel cells are gaining ground, while innovative concepts are helping maintain the supremacy of the internal combustion engine.

Internal combustion engines continue to dominate in the private transportation sector, since a variety of approaches and advanced technologies in fuel consumption and emission controls have made enormous strides forward.

In addition, diesel and gasoline still account for most of the fuel market. However, gas, methanol and hydrogen are more and more common now that an extensive, convenient and reliable infrastructure has been established to distribute them.

Researchers have discovered that ambitious consumption and emission reduction targets can be met simply by modifying a large number of different parameters. Both direct injection and multipoint injection methods are used, and variable compression and charging are now playing an important role. This development was pioneered by much faster and more sophisticated fuel metering technologies that use electromagnetic and piezo-electrical components. However, exclusively electrical drives and hybrid concepts still account for increasingly larger segments of the automobile market.

In this context, a distinction must be drawn between the energy used to propel a vehicle and the energy – such as heat and electricity – needed to operate it. There are different approaches to each type. Fuel cells are frequently the sole electricity supply, since it is possible to introduce and further develop this technology using methanol as an intermediate step.

The development of a 42V on-board power supply for passenger cars has made it easier to power energy-intensive loads like air conditioners. It has also enabled us to replace hydraulic components with electrical ones. This trend – coupled with the development of advanced energy management systems which were introduced at the same time – has set milestones in lowering fuel consumption and in developing motor vehicles. Developers have drawn a great deal of inspiration for sophisticated energy management systems from hybrid concepts, where it is often necessary to switch back and forth between combustion and electrical drives.

4.7 Combining Biotech, Nanotech and IT

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Most important trends

- Information technology is everywhere, touching all areas of daily life.
- Quantum mechanics dominates integrated circuit design.
- Photonics is finding its way into real-life applications.
- Repairing and augmenting cellular components at the molecular level by molecular prosthetics
- Customized replacement parts for the human body by implantable, biocompatible nanomaterials
- Delivering drugs and other therapies to precisely where they are needed by nanomaterials
- Detecting and measuring biological reactions at the nanoscale level with biosensors

Abstract

Nanotechnology and the new technological paradigm it has created have been key factors in the realization of ubiquitous computing – the interlinking of electronic equipment of all kinds to make information available anytime and anywhere. Parallel to this development, advanced new system architectures and security strategies have emerged to safeguard privacy. Transforming components into information and communication systems involves uniting individual elements within a defined architecture. Functionalities previously achieved using transistors, switching elements and memories are implemented today at much smaller sizes using nanocomponents.

Quantum mechanics dominates the design of sub-nanoscale electronic components. Specific phenomena only encountered at nanoscale – above all, quantum mechanical effects – are being exploited to create smaller, better and/or faster electronic components.

Photonic crystals form the basis of photonics (electronics based on light as opposed to an electrical current). Photonic crystals are to photons what semiconductors are to electrons. The availability of high-quality three-dimensional structures opens up enormous application potential for nonlinear optics and quantum optics in information and communication technologies.

Molecular prosthetics are used to correct or augment proteins and other structural elements at the cellular and sub-cellular levels. Significant advances in the area of systems biology have led to a detailed understanding of the functions of proteins within cells. Nanomolecular structures can now be designed that can bind to defective proteins and restore their “normal” structure and function.

Biocompatible nanomaterials are effectively used in surgical implant procedures to replace defective body parts. Using sophisticated software, scientists are able to model and simulate the nanoscale cellular reactions associated with the inflammatory response that takes place in particular materials when they come in contact with blood and tissues. Nanomaterials can be designed with appropriate topographies that minimize interactions that could potentially affect cell movement and growth and that minimize undesired immune effects.

Developments in nanotechnology have enabled and enhanced the delivery of drugs and other compounds that are not easily internalized by the body. Nanoscale carrier molecules are designed to be biocompatible and biodegradable, so that they don't cause undesired side effects and can be cleared from the body after they have delivered their payload. These molecules also exhibit sustained and controlled release profiles, delivering the correct dosages of drugs when and where they are needed.

Biosensors are now used in many areas of medicine, where there is a need for fast and accurate diagnosis. In acute care, biosensors are used for such things as basic blood chemistry (gases, electrolytes), the detection of biomarkers associated with heart attacks and strokes, and monitoring of administered drugs. In sub-acute care, biosensors are used to monitor infectious disease, hormone levels and for blood cell typing.

■ Invisible intelligence

Future trends

Information technology is everywhere, touching all areas of daily life. This pervasiveness has come about as a result of continued miniaturization and cost reduction, driven more than anything by progress in the field of nanoelectronics.

The most important technological factor in the emergence of ubiquitous information technology is semiconductor-based electronics, now dominated by quantum mechanical modules. Constant growth in the integration density and performance of integrated circuits – coupled with a steady decline in specific costs – has made microprocessors cheap to produce on a mass scale, with the result that they are now in practically every device and appliance in daily life. This trend has led to an upgrowth in inexpensive information appliances, made with the smallest and cheapest processors, memories, and sensors, capable of communicating wirelessly, and designed to handle specific tasks.

For nanotechnology to achieve a breakthrough in the information and communication technology market, conventional microstructuring processes first had to make the leap to nanotechnology and utilize self-organizing processes to create circuits and systems. Nanotech energy sources have more than twice the energy density that they had ten years ago. Today, energy can be extracted much more effectively from the environment than before and in a variety of ways, including tapping mechanical energy with the aid of vibrating window panes, and exploiting our bodies' physical movement and waste heat. DNA computing and quantum computing – areas of technology now fully charted by the scientific community – have given rise to system architectures designed to handle specialized, massively parallel processing applications. These system architectures are finding their way into new products due to reach the marketplace shortly. This will fuel a sharp increase in computing power. There are no plans as yet to use the same technology in personal computers.

Nanotechnology and the new technological paradigm it has created have been key factors in the realization of ubiquitous computing – the interlinking of

electronic equipment of all kinds to make information available anytime and anywhere. Parallel to these developments, advanced new system architectures and security strategies have emerged to safeguard privacy. These advances have spawned the creation of small, powerful and inexpensive sensors and processors used to make so-called smart objects – wireless-equipped devices that enable ad hoc networking. Low-end, low-cost polymer electronics based on conductive synthetic materials are now a common means of incorporating basic intelligence into even throw-away items, such as smart labels for use on packaging.

Healthcare:

Advances in the miniaturization of electronic components and the development of large numbers of small but powerful sensors are creating interesting new possibilities throughout the entire healthcare sector. New breeds of sensor, many engineered using nanotechnology, enable continuous, non-intrusive monitoring of key medical parameters when worn on the body, helping to improve the planning and supervision of the diagnosis and treatment of conditions. Networking large numbers of small sensors has also made it possible to register human feelings, emotions and stress.

Autonomous service robots:

These have long been used to care for the sick and the elderly. Combining high computing performance with a compact format and low energy consumption, these robots are capable of real-time object and voice recognition and operating in real-life environments. They also have the ability to learn complex processes and, thus, to adapt to new situations and environments that they encounter.

Commerce:

Some years ago, bar codes were superseded by smart labels in the retail and procurement sectors. Soft nanolithography has made possible the manufacture of curved dies for printing polymer electronics onto non-planar surfaces and at an extremely low cost. A large number of new services based on the intelligent management of information streams – including automated recording of

the prices of goods in consumers' shopping carts, autonomous monitoring of inventory levels and logistics streams, and intelligent order management – are used in the retail sector.

■ Quantum mechanics dominates integrated circuit design.

Future trends

Quantum mechanics dominates the design of sub-nanoscale electronic components.

The evolutionary transition from microtechnology to nanotechnology in the past ten years has led to further miniaturization and performance increases in semiconductor components. Moore's laws, which state that –

- chip capacity doubles every 18 months, and
- the cost of manufacturing equipment rises in direct proportion to the number of transistors in an integrated circuit

– may have been valid in the past, but increasingly, rising investment costs are imposing limits on Moore's first law.

The doubling of the capacity of integrated circuits has been influenced by three factors: resolution-enhancing improvements in lithography processes; greater chip surface areas; and reductions in the size of components. CMOS technology remains a key platform for implementing memory and logic components. The ever-increasing degree of miniaturization has meant higher switching speeds, lower power requirements, and higher integration densities to sub-10nm, thanks to innovations in materials science. Optical lithography is an inexpensive method of transferring chip structures from masters to the base material used in chip manufacture. The limits of CMOS technology are closely tied to the limits of lithography because the wavelength of the lasers imposes a cap on the resolution of the structures that can be created. Twenty years ago, the resolution limit was 90nm, but today's processes are on the brink of taking it below 30nm. Soft lithography methods like printing, stamping, molding and embossing are now

well-established and extremely affordable methods of manufacturing polymer electronic systems printed onto thin foils, which are a base technology for consumer-sector applications, such as smart labels.

New components:

Products and methods from the realm of nanotechnology are being used to an increasing degree in the semiconductor industry. Materials like carbon nanotubes and quantum points are original nanotech structures that are suitable for use in familiar component types and for creating entirely new components. In both cases, specific phenomena only encountered at nanoscale – above all, quantum mechanical effects – are being exploited to create smaller, better and/or faster electronic components.

- Resonance tunnel diodes and resonance tunnel resistors, for instance, mark a logical onward development of classic semiconductor technology. Today, they provide the basic building blocks for the majority of electronic circuits and are the most widely established nanoscale components, because they are generally manufactured in conventional solid-state technology and can operate at room temperature. Resonance tunnel elements are small, consume little power, and achieve high switching speeds. They can also take on more than just the two basic states of on and off, making it possible to design multi-value logic circuits with fewer components.
- Single-electron transistors made of semiconductor materials are especially interesting in terms of their potential because of their compatibility with conventional CMOS technology and because they only need a single electron in order to change their circuit state. They are based on quantum mechanical principles, consume little power, and produce little heat. They are extremely small and are poised to succeed conventional solid-state semiconductor technology because they work with structure sizes of less than 20nm.
- With single-flux-quantum logic and the very latest superconducting materials, high-frequency circuits can be built to operate at speeds ranging from 100GHz to over one terahertz and to consume less than 1 μ W of energy per gate.

- Field effect transistors made of carbon nanotubes offer interesting possibilities in logic because a number of the tubes' intrinsic properties – their narrow diameters, their metallic, semiconductor characters and their high transport rates – make them ideal quantum components.
- Magnetoelectronics (or spintronics) exploits the magnetic resistance effect that's exclusive to nanoscale components. Magnetoelectronic components pave the way for making combined use of electrons' spin and charge to create functional structures. These components are used in memory and sensor technology and in information processing. Having been a standard memory technology for many years, they are now gradually being used in logic elements, too.
- In molecular electronics, the properties of organic or biological macromolecules provide a foundation for implementing specific functionalities and components. Their fields of application revolve primarily around the integration of information technology and biological systems – for example in biosensors and in neuroprosthetics, where they are used to attach conventional electronics to nerves. The application of biological principles is driving the successful development of fault-tolerant architectures and error-correcting algorithms.
- The trend in memories has shifted away from DRAM/SRAM toward inexpensive nonvolatile, high-speed memory with low power requirements and high integration densities. The gap between main memory and conventional hard disk storage is being bridged by a variety of intermediate technologies, including advanced hard drives, nanomechanical data storage media, optical media and nonvolatile main memories.
- **Photonics is finding its way into real-life applications.**

Future trends

New types of logic components based on coupled quantum points (photonic logic) and photonic transistors have become a reality. Prototypes of quantum computers have been built. Red, green and blue quantum point lasers are available, and images with exceptional color integrity can be created electronically.

Quantum points are formations consisting of just a few thousand atoms. One of their specific applications is in quantum point lasers. These lasers play an important role in telecommunications because they can be tuned to emit light at a wavelength of $1.3\mu\text{m}$ to match the transmission properties of optical fiber. The emission wavelength is determined solely by the size of the quantum point.

Photonic crystals form the basis of photonics (electronics based on light as opposed to an electrical current). Photonic crystals are to photons what semiconductors are to electrons. They are made of a dielectric (a non-conducting material that can sustain an electrical field) with a periodically structured refractive index. This creates a photonic band gap, which is akin to a band gap in a semiconductor. The availability of high-quality three-dimensional structures opens up enormous application potential for nonlinear optics and quantum optics in information and communication technologies. Photonic crystals are used in light-emitting diodes, lasers and photonic logic. It is now possible to create photonic transistors.

Nanotechnology-based systems and new architectures:

DNA computing and quantum computing:

Transforming components into information and communications systems involves uniting individual elements within a defined architecture. Functionalities previously achieved using transistors, switching elements and memories are being implemented today at much smaller sizes using nanocomponents. These have made it possible to create conventional information technology and telecommunications systems not just with CMOS nanotechnology but with quantum electronics components, too. The transition from traditional microelectronics to nanoelectronics has not involved an architectural paradigm shift. Circuits and systems today can be designed efficiently thanks to the availability of powerful design tools and fault-tolerant architectures, which have been developed using the statistical properties of quantum physical effects. Particularly interesting are those architectures that make use of the special properties of nanotechnology to implement functionalities in telecommunications and, to an even greater degree, in information technology in entirely new ways. Areas of application range

from conventional parallel processing to soft computing methods (a branch of computing that tolerates imprecision, uncertainty and approximations), DNA computing and quantum computing.

- DNA computing achieves massive parallelism that can be brought to bear on search problems. However, this enormous computing power is confined to just a small number of operations, and DNA computations are inherently error-prone. DNA computing is used to implement evolutionary algorithms, because their core components – population, mutation and selection – correspond directly to elements in DNA technology. Other fields of application include cryptography and the use of suitable key molecules.
- Quantum computing gained considerable momentum as a result of the first quantum algorithms and on the strength of the scope afforded by nanotechnology for creating viable experimental setups. Like the bit, the smallest information unit in conventional computing, a quantum bit or qubit, the basic unit of information in quantum computers, can assume either of the two states representing two logical values; however, it can also assume both of these states at once. The superposition of several qubits – termed an entangled quantum state – is an essential characteristic of quantum systems and enables the parallel storage of different quantum states with just a small number of qubits. Experiments in nanotechnology helped to underpin the theoretical concepts of quantum computing and to develop them to the point where they were ready for practical application. Thanks to quantum computers, massively parallel information processing is becoming viable. Key areas of use are cryptography and image recognition.

■ Molecular prosthetics

Repairing and augmenting cellular components at the molecular level

Future trends

In addition to gene therapy that corrects genetic defects at the DNA level, molecular prosthetics are used to correct or augment proteins and other structural elements at the cellular and sub-cellular levels.

Significant advances in the area of systems biology have led to a detailed understanding of the functions of proteins within cells. In addition, the development

of sophisticated molecular modeling and simulation technologies has allowed scientists to accurately determine the effect of genetic mutations on the three-dimensional shape of proteins and the resulting effects on function. Using this information, nanomolecular structures can now be designed that can bind to defective proteins and restore their “normal” structure and function.

Molecular prosthetics are designed using small organic or inorganic molecules that bind to defective proteins at highly specific sites. Binding of a prosthetic to a defective protein restores its original 3-D structure, primarily through an electromagnetic interaction between the molecules that “pulls” the protein back into shape. Once designed and modeled on a computer, the prosthetics are synthetically created and packaged into highly specific carrier molecules as part of a targeted delivery strategy. These molecules carry and release the molecular prosthetics where and when they are needed in the body.

Using advanced diagnostic technologies such as biochips, doctors now routinely screen patients for mutations in DNA that encode functionally significant molecules. If such mutations are found, drugs containing molecular prosthetics that specifically target these molecules and repair them can be prescribed.

Molecular prosthetics are commonly used to treat diseases that are associated with the impairment of important cellular proteins, such as ion channels and protein signaling receptors. Defects in these proteins have long been known to be associated with diseases such as cystic fibrosis, diabetes and hypertension. Molecular prosthetics are also used to target structural proteins, such as muscle or nerve fibers, providing treatments for people who are bedridden or have degenerative neuromuscular diseases. Another major application area is in blood processing, where molecular prosthetics are used to produce hemoglobin blood substitutes to improve oxygen-carrying capacity and to augment or enhance the functionality of blood clotting factors for people with hemophilia or for those suffering from heart disease.

Molecular prosthetics are also widely used in the nutraceutical industry where they appear in cosmetics or as dietary supplements that improve sensory and functional performance. The aging population spends considerable money on cosmetics such as enhanced skin creams that enhance such things as the structure of collagen and elastin. Athletes, such as long distance runners and cross-country skiers, frequently use supplements to enhance their endurance. Similar applications exist in military applications, offering soldiers heightened physical attributes such as increased strength, speed and endurance during combat.

■ Implantable, biocompatible nanomaterials

Customized replacement parts for the human body

Future trends

Biocompatible nanomaterials are effectively used in surgical implant procedures to replace defective body parts. Advanced simulation and modeling software that incorporates a patient's genetic profile and cellular biochemistry with the molecular topology of materials is key to this development.

In the past, implantation of foreign materials into the human body resulted in the development of many chronic disease conditions and even death following surgical intervention. The adverse reactions resulting from implantation occurred due to the body's innate ability to react to foreign materials through an inflammatory response. This response is protective in normal disease or wounds, and ensures proper activation of the immune response or clotting of coagulation factors in the blood. However, in extreme conditions or at chronic wound sites, the inflammatory response can trigger a cascade reaction that can lead to tissue damage.

Doctors now have a thorough understanding of the genetic and molecular mechanisms associated with the inflammatory response. Using sophisticated software, scientists are able to model and simulate the nanoscale cellular reactions associated with the inflammatory response that takes place on particular materials when they come in contact with blood and tissues. Furthermore, the genetic basis of the immune system reaction that is associated with the inflammatory

response is known. Using this information, nanomaterials can be designed with appropriate topographies that minimize interactions that could potentially affect cell movement and growth and that minimize undesired immune effects.

Due to the aging population and the increase in the human lifespan that has resulted from advances in biomedical science, joint and tissue replacement using biocompatible materials are commonplace procedures. Common procedures include hip, shoulder and ankle replacement, and the replacement of defective heart valves. The materials used in these procedures have low failure rates and can be implanted for long periods of time, often for the life of the patient.

Biocompatible nanomaterials have also facilitated the development of brain-machine interfaces and neuroprosthetic devices. By establishing direct links between neuronal tissue and machines, these devices significantly enhance a patient's ability to use voluntary neuronal activity to directly control mechanical, electronic and even virtual objects as if they were extensions of their own bodies. This is especially useful in patients suffering from neurodegenerative diseases and in individuals who have had a stroke or suffer from seizures. In these cases and many others, intelligent implants made out of custom-engineered nanomaterials can aid in the restoration of neural function, cognitive thought and independence, and thus play a major role in enhancing quality of life.

■ Nanomaterials for drug delivery

Delivering drugs and other therapies to precisely where they are needed

Future trends

The increasing development of bioengineered drugs led to a shift from traditional passive delivery systems into active, “smart” delivery systems that can recognize the site of drug action and release a drug payload directly at cellular or intracellular targets.

Developments in nanotechnology have enabled and enhanced the delivery of drugs and other compounds that are not easily internalized by the body. This

includes many large molecule, biologically based drugs such as proteins and peptides that can exhibit low solubility and permeability. Without the aid of advanced carrier systems designed at the nanoscale level, many of these molecules could not be taken orally due to poor permeability and instability in the gastrointestinal tract, and therefore could not effectively reach their desired targets.

Nanoscale carrier molecules are designed to be biocompatible and biodegradable, such that they don't cause undesired side effects and can be cleared from the body after they have delivered their payload. These molecules also exhibit sustained and controlled release profiles, delivering the correct dosages of drugs when and where they are needed. Additionally, these carriers can be used with alternative routes of delivery, such as inhalation and needle-free injection devices. Unlike drug delivery systems of the past, these new methods afford patients freedom from the pain and side effects of pills and injections.

Nano-carrier systems also play a major role in gene therapy. Although synthetic replacement genes can now be easily and rapidly generated, efficient and effective mechanisms are required for delivery to target cells. Molecules that carry the genes have been engineered to protect against degradation and to bind to specific receptor sites on target cells. This highly specific binding triggers a process whereby they are internalized into the cells. From here, the carrier travels to the nucleus and penetrates the nuclear membrane, delivering the replacement genes in range of the target DNA that is to be modified.

Drugs, vaccines and other therapies are encapsulated in a variety of nano-carriers. A few of the many nanomaterials that are in use include carbon nanotubes, modified or augmented viruses, plastic vesicles covered with antibodies and nanoporous membranes.

Nanoparticles can be designed to enter damaged cells and release enzymes that initiate the cells' auto-destruct sequence. Alternately, these particles can release enzymes or other molecules (such as molecular prosthetics) that can repair malfunctioning cellular components, thereby restoring normal cellular function.

Nanoporous membranes, which contain pores that are only slightly larger than the molecular size of the drugs they carry, are used to provide a constant diffusion rate regardless of the amount of drug remaining in the capsule. These membranes are routinely used on implantable devices for the treatment of chronic diseases.

Nanoscale delivery systems are routinely combined with non-invasive imaging modalities, such as MRI, PET, ultrasound and optical devices. Nanomaterials used in these scenarios have been designed to respond to various forms of focused energy such as magnetism, ultrasonic frequencies and specific wavelengths of light. When exposed to such energy sources, they undergo a structural change. This principle is used to cause the release of drugs or other therapeutics at a site where energy is focused.

■ Biosensors

Detecting and measuring biological reactions at the nanoscale level

Future trends

A variety of nanoscale analytical devices that intimately combine biological and physical elements have been created to detect and measure a variety of physiological stimuli. These devices play a fundamental role in a variety of diagnostic and therapeutic approaches, dramatically improving patient care while cutting overall operating costs of healthcare delivery.

The development of nanodevices that facilitate the intimate combination of signal production and detection with a reduced need for sample pre-processing has opened up many areas of decentralized, accurate testing. A major medical application of this technology is point-of-care monitoring. In this scenario, the use of biosensors has led to a huge reduction of the time from patient sample to analysis to a therapeutic decision, and reduced reliance on delicate equipment and specially trained personnel.

Biosensors are now used in many areas of medicine, where there is a need for fast and accurate diagnosis. In acute care, biosensors are used for such things

as basic blood chemistry (gases, electrolytes), the detection of biomarkers associated with heart attacks and strokes, and monitoring of administered drugs. In sub-acute care, biosensors are used to monitor infectious disease, hormone levels and for blood cell typing. For chronic diseases, such as diabetes, high blood pressure and arthritis, biosensors are used in conjunction with smart drug delivery systems and implantable devices to monitor levels of target biomarkers in the blood and control the corresponding release of drugs.

A major application of biosensors is in the area of biochip production. Advanced biochips have been created utilizing the latest developments in bioelectronics, nanotechnology and micromachining. Over the past few years, there has been a gradual shift from utilizing techniques such as photolithography (which can create sub-micron features in inorganic material and organic polymers) to technologies such as atomic force microscopy that can manipulate individual atoms and molecules at the nanoscale level. This has facilitated the replacement of inorganic semiconducting oxides found in traditional “silicon chips” with molecules such as bioengineered proteins that are capable of communicating via optical or electrochemical mechanisms. These chips provide low cost, high speed, highly selective screening of a variety of biological materials.

Biosensors that are integrated into advanced biochips are used to screen a patient's DNA, proteins or other biomarkers in diagnostic and therapeutic scenarios. Common tests utilizing biochips include the diagnosis of genetically-linked diseases (such as various forms of cancer) and analyzing a patient's genetic profile to determine an optimal drug therapy (pharmacogenomics). Such tests form the cornerstone of personalized medicine, which is now a reality.

The traditional biosensor design that contains bioelements (organic molecules which create a recognition event) and physical elements (transducers that convert the recognition event into an electrical signal) has undergone several stages of evolution. Current biosensors integrate higher selectivity, improved stability, better sensitivity and new specificities, as compared to earlier designs.

The bioelements used in early biosensors consisted of enzymes, antibodies and genetic material (DNA or RNA). Now, bioengineering has enabled the creation of new classes of bioelements that are constructed at the nanoscale using modeling and simulation software. These bioelements are designed with highly specific three-dimensional shapes that allow them to selectively bind to target molecules, such as specific large protein molecules that have been identified as biomarkers of disease.

In addition to medical applications, biosensors are now used in a number of other areas, such as environmental analysis, food and beverage screening, and drug manufacturing. In all of these scenarios, biosensors provide fast, on-line, real-time sensing that permits control and optimization through interactive feedback mechanisms. This is achieved through the integration of biosensor readings with advanced decision support-systems and pattern-matching algorithms that can, for example, detect trends in the data and suggest or deploy appropriate actions.

5 Attachment

5.1 Trend breakers

In the wake of the presentation and discussion of the two scenarios, various ‘trend breakers’ or disruptive factors were put forward in conjunction with the advisory committee, factors which would influence the scenarios to such an extent that they would lose all validity and would thus have to be rewritten.

Six different ‘trend breakers’ were developed.

1. **Natural catastrophes** (earthquakes in Europe, a shift in the Gulf Stream as a result of the greenhouse effect, causing the onset of a new Ice Age, climatic catastrophes such as a high increase in temperature or a drought in Africa, causing a mass flight of natives into Europe)

Due to the fact that the majority of these developments either take place over a long period of time or are confined to specific regions only, it is possible that they could either intensify or weaken a particular development of phenomenon described in one of the two scenarios. However, both scenarios remain valid. Only an extremely sudden natural catastrophe affecting Europe as a whole could change the scenario in a radical way or invalidate it totally.

2. **War and terrorism** (regional deployment of atomic weapons, attacks on infrastructure facilities such as power stations, roads, rail or air traffic, dramatic increase in crime levels). As long as the above remains confined to limited occurrences on a regional scale, the development described in the scenarios should proceed as predicted.
3. **Political events** (USA resigns from the UN, the UN dissolves, division or dissolution of the EU, massive increases in energy costs as a result of changes in political relations with the Middle East). It is possible that a limited number of the developments described in the scenarios could be intensified or weakened as a result of the above. However, the scenario retains its validity.

4. **Loss of trust in technology** (nuclear energy disasters as a result of system failure, smog becomes an acute health risk, spam and viruses paralyze software and the Internet). The openness toward technology which has reigned so far could be put at risk, although this would be with regard to long-term technical developments. The introduction of new technical applications can be delayed, or technical solutions for the reduction of dangers will be developed (mobile phones protected against harmful rays, for example). The scenario remains valid. This also counts in the case of system-related nuclear energy accidents, as long as they cannot be considered major disasters contaminating whole regions.
5. **Dangers to health** ('information fatigue' as serious psychological syndrome, new illnesses and epidemics). These developments are mentioned specifically in the course of the scenario descriptions, and do not threaten their validity.
6. **Radical changes in the structure of the population** (sudden increase in the aging population, abrupt decline in birthrate). The effects of this on the population as a whole remain negligible until 2020. Some developments described will be intensified or reduced as a result of the change in population structure, but the scenario will retain its validity.

A thorough analysis of these trend breakers demonstrates that only massive natural catastrophes affecting entire regions or European-wide catastrophes as a result of war, terrorism and technical disasters would have the power to change the living world so drastically that the scenario described could lose its validity.

5.2 Advisory Committee

The scenario's development was followed by a scenario advisory committee formed of experts from differing academic fields, who ensured that all relevant influences were considered.

The advisory committee was composed of the following persons:

- Dr. Harald Bradke, Fraunhofer Institute of Systems Technology, Karlsruhe
- Thomas Ellerbeck, German Lufthansa, Frankfurt
- Gabriele Fischer, Chief editor of brandeins, Hamburg
- Dr. Andrea Fleuchaus, patent lawyer, Munich
- Dr. Hartmut Kiock, Kiock, Hampf & Partner, Paris
- Hartmut Raffler, Siemens AG, Corporate Technology, Head of Information & Communications, Munich
- Prof. Dr. Ulrich Steger, International Institute for Management Development, Lausanne

The project team from TNS Infratest consisted of:

- Dr. Joachim Scharioth
- Dr. Margit Huber
- Katinka Schulz
- Martina Pallas

The following guests were present at the advisory committee meetings:

- Dr. Barbara Filtzinger, Siemens Corporate Communications, Munich
- Gerhard Hütter, Siemens Corporate Communications, Munich
- Christiane Dirkes, Weber Shandwick Worldwide, Munich

Attachment – Advisory Committee

During the writing of the scenario, the advisory committee met three times to discuss the following topics:

- The forming of specific social models, regional boundaries, choice of milieu and development of alternative descriptor forms
- Assessing the result of expert questioning, final decisions regarding the critical descriptors
- Discussing the precise description of the milieus involved, critical discussion of the “future reservoir” of ideas for describing the various living worlds in addition to the collection and assessment of potential trend breakers

5.3 Descriptors

Below, various crucial ‘descriptors’ or descriptive factors are listed, which proved to have a decisive influence during the scenarios’ creation. So-called ‘megatrends’ count among these, factors which have a strong influence over inevitable future developments. Secondly, so-called ‘critical descriptors’ are listed, which could develop in an alternative manner from the way predicted, thus taking the form ordained for them in either scenario 1 or in scenario 2. Thirdly, so-called ‘uncritical descriptors’ are listed, which, although based on the results of expert questioning, were ascribed a particular direction for their development by the experts.

Descriptors – Scenario 1

Legend: ***Critical descriptors that have a high relevance for a positive future**
 Other critical descriptors
 Uncritical descriptors/megatrends

A2 A large number of areas within society are regulated by the government. Water supply, education, health, but also IT-infrastructures are areas regarded to be of such importance that people do not wish them to be subject to market development. As a consequence, direct governmental industrial policies are partially implemented.
A3* Government institutions are clearly and comprehensively structured from regional to pan-European level. The public knows where specific decisions are made and is aware of the various government departments and their responsibilities.
A5* Thanks to international co-operation the governmental monopoly of power remains unchallenged. This ensures legal security, protects citizens from terrorism and all types of crime.

A7*

Government, politicians and society have the power to find valid solutions in areas such as old age pensions and public health care.

A10*

Reforms in the social market economy have been in line with globalization.

B2

The nation state has successfully defended its position. A European foreign minister is in place; however, political decisions are still made within each nation state.

B4

As a command force, the USA and its allies fulfill their duty to keep peace and order in the world.

B6

European institutions still require majority consent of the respective nation states. Influence exerted by the European parliament is limited.

B8

Large economic federations have failed to live up to their own standards. The idea of a “Europe 35” did not work, because of economic and national differences.

B9

Europe clearly has distanced itself from other states (confederations) and economic areas. Therefore, to a certain extent, it has gained economic autonomy.

C2

Religious communities fail to meet society’s demand for a purpose in life. The majority of the public ignores religious communities and instead finds fulfilment in everyday life with its inherent values and claims.

C3

Political parties are the decisive medium for the formation of political opinion. European parties act on all levels, from council up to European elections.

C6	NGOs have no political significance. They are denied a formal involvement in decision processes.
C8	Political institutions insist on their exclusive responsibilities and competencies, so it is difficult to exert any influence via citizen initiatives.
C9	Trade unions have gained a large number of members within new jobs in the service sector. Their international outlook also allows them to exert influence within enterprises acting on a global scale as well as within politics.
C11*	Together with trade unions the business associations exert influence also on a supranational level in everyday working life. Their commitment to shared norms and standards, international agreements and the exchange of experiences between businesses is highly regarded.
C13	Political opinions are formed on the basis of representative democracy. Elements of basic democracy are insignificant.
D1	The media is a powerful force within society and thus influences decisions in the economy and politics.
D3	Freedom of the press is one of the most important assets within the international community. The press has a right to protection of sources and limited liability.
D5*	The combination of public and private media leads to a wide variety of opinions. Information and commentary are kept separate.

D8
Copyright, together with technological developments to protect intellectual property, gives providers the key role in the dissemination of ideas and works.
D9*
Scientific and economic inventions are protected by internationally valid patents.
D12
A number of World Wide Webs have developed in parallel. As a consequence, innovative force, uncontrollable content and random diversification are on the increase.
E2
Society tends to hold onto tried and tested ways and is sceptical, even hostile, toward change.
E3
Society has clearly established moral values. Enterprises, organizations as well as individuals are assessed according to the degree to which they behave in a fair, considerate and responsible way.
E6
Consumerism occurs casually and is no measure of status.
E7
Individual self-realization and the responsibility for one's own well-being are at the top of the hierarchy of values.
E9
The multi-cultural composition of society and its variety of lifestyles brings with it a range of ever-changing moral concepts.
E11
Everybody feels responsible for their own lives, development and personal actions. Assuming responsibility for your own actions, pro-active and entrepreneurial behaviour are recognized values.

E14

The trend toward globalization provokes fear and insecurity rather than openness in individuals. Increasingly, people once again look for fixed points in their immediate surroundings and have reservations with respect to foreigners.

E15

The variety of languages is greater than ever, national languages are supplemented by regional languages (e.g. Gaelic).

E18

The effort invested in the work-place and development of working life are the decisive factors in terms of peoples' standing in society.

E20

Time is not a class-specific criterion.

E21

Virtual worlds play an important role for a number of people – especially adolescents. To some extent they isolate themselves from the real world around them.

E23

All classes, rich or poor, get recognition through the consumption of cheap products. Discounters gain in importance.

E25*

Security has become an important asset. The government successfully guarantees public security. Measures to improve security are met with broad acceptance.

E27

Personal freedom and privacy are valuable assets. Protection of privacy is highly significant, any form of surveillance is rejected. There is no such thing as a "transparent consumer".

F1

Individuals are free to choose their lifestyle. Society is tolerant and accepting toward the most diverse of lifestyles.

F3* Children and family are one of the greatest values within society. The society is child-friendly. Family and career can both be reconciled.
F5* The difference in income between rich and poor does not vary significantly. The social welfare systems ensure that everyone has a modest disposable income.
F8 Core Europe is the aim of many non-European-immigrants, causing growing intolerance against them.
F9* People feel a sense of responsibility for future generations.
F12 Regions situated in the south and east of Europe noticeably lag behind the general level of development.
F13* Increasing urbanization is accompanied by a revival and enhancement of rural areas.
G1 Education is one of the most important values of all. Everyone depends on a lifelong learning process. Governmental as well as private education expenditures are on the increase.
G3 To a large degree the government sets educational targets, designed with a view to continuity.
G5 The government funds education from elementary schools to universities up to institutes for further education.
G7 Businesses are aware of the importance of education for their future success and are therefore involved with their own educational institutions.

G9*
There are interchangeable transitions between countries and educational systems. A mutual acceptance of scholastic degrees was a key step in achieving this goal.
H1
Private expenditure for transport infrastructure as well as a continued privatization of this sector has led to a relief for the public sector.
H4
People try to avoid this constant availability, e.g. through “time outs”.
I1
Health is the most important value and status symbol in an ageing society. People are prepared to spend a considerable proportion of their income on it.
I3
Doctors are obliged to take life-prolonging measures. The majority of elderly people in need of medical attention are taken care of in nursing homes with doctors and caregivers bound by the obligation to take life-prolonging measures.
I6
Health research is guided mainly by social necessity. Research funds are geared predominantly toward curing illnesses affecting a great number of people.
I8
The treatment methods on offer are limited, there is a clearly defined protocol of recognized medical practice.
I9
There is a considerable amount of private health care expenditure. All services within the health care system require additional individual contributions.
J2
Economic growth in Europe is stagnating and there are considerable differences between the respective GNPs of individual European countries.

Attachment – Descriptors

J4

Europe as a center of industry has been unable to keep up with the global competition and as a consequence, has turned largely into a society of trade and services.

J5

The strong focus of businesses on increasing efficiency has led to constant pressure on pricing, combined with a low level of service.

J8

The reduction of free disposable income in private households has restricted the demand for new, intelligent services largely to businesses. Within the private sector people tend to concentrate on so called do-it-yourself services (such as home improvement).

J10

Free disposable income remains stagnant or is even diminishing.

J11

Increased costs of mobility, self-financing of health care, retirement provisions and security do not provide too much leeway for private consumption.

J14

Large corporations have been broken up again. An active policy for small and medium-sized enterprises has led to a situation in which these enterprises, acting on a global scale, form the backbone of the European economy.

J16

A marked division of employment between the regions occurs, leading to a strengthening of the tertiary and quaternary sector in Core Europe and Northern Europe. In Eastern Europe the secondary sector remains the primary economic force. In Southern Europe the tertiary sector has grown primarily as a result of tourism, leaving behind the quaternary sector.

K1

There is a flexible employment market in which every form of employment is possible. Businesses distinguish between core employees with fixed contracts and a peripheral workforce with flexible contracts.

K3
There is a wide variety of working-time models. Annual or lifelong working-time models allow for completely new ways of alternating between working and leisure time.
K5
Lifelong employment duration is rising as a consequence of the ever-rising age pyramid.
K7
In view of high levels of tax and additional wage costs, the shadow economy plays a major role.
L1
Sustainability as a principle is relevant to management, i.e. alongside economic, ecological and social goals.
L3*
Active innovation management involves great expense for research and development. The competition for leadership in the field of innovations is fierce, but due to the constant demand for new products and services also very profitable.
L5
The mass product customized to specific customer wishes, (i.e. the possibility to customize cars to several thousand specifications) has led to a vast variety of products. This is not only valid for durables but also for services and consumer goods.
L8
It is still impossible in most countries to assess a brand's value on a balance sheet. As a consequence of the dominance of no-name products and trade brands, branded articles and also the brand are of secondary importance.
L9
Businesses increasingly concentrate on their core abilities and outsource all other services.

L11

The relationship with customers, employees and suppliers is an important factor of competition.

L13

Recognition of the direct relationship between employee satisfaction and profitability of a company has turned human resources into an important factor and has resulted in the investment in further training.

M1

Technological impact on the environment is a relevant criterion in the decision-making process of enterprises.

M3

Quality of the environment is seen as a factor determining quality of life altogether. As a consequence environmentally friendly technologies are widely welcomed and environmental activities are supported.

M5*

The individual is prepared to accept a lower quality of life in order to preserve a world worth living in for future generations. Nowadays sustainable management can also be measured on a microeconomic level. This makes decision-making of truly sustainable measures possible.

M7*

Consumption of resources continues to rise on a global scale. Resources are available in sufficient quantities thanks to the creation of new material acquisition capacities, the use of alternative technologies and the environmentally responsible handling of resources.

M9

Political actions are geared toward strategies for the prevention of using anything which could potentially cause or reinforce a change in climate.

M12

The importance of the use of energy with a view to improving environmental quality and climatic protection has been recognized not only by the government and businesses, but also by individuals changing their behavior.

N2

Early recognition of the global rise in demand for food due to the population increase has given rise to active management of food supply and more efficient technologies.

N3

Organic food is preferred. Every care is taken not to allow fertilizer and pesticides to enter into the food chain in the first place and to clear water as well as soils from harmful substances.

N6

A large number of states reject the privatization of water supply.

O1

Society is marked by a wide openness toward new technologies.

O4

Safeguarding against major threats is left in the hands of private business up to a certain amount, beyond which the government steps in.

O5

The clearly defined role of regulators enables the privatization of primary supplies such as energy, telecommunications, postal services or water and thus prevents unjustified high prices.

P1

The fuel cell has become the most likely technology to contribute to the decarbonization of traffic. For stationary applications a large number of fuel cells have already been implemented.

P4

Large power plants linked via grid systems form the backbone of energy generation in Europe.

P6

The risks perceived with nuclear power such as large-scale accidents in nuclear power plants or access to fissile material by terrorists or nations have led to a European-wide renunciation of nuclear power beyond 2040.

P7

Due to economic growth and increase in population, energy requirements have grown considerably. Light, heat and power have become more vital in an increasingly technological society.

Q2

Thanks to its logistical experiences stationary trade has asserted its position at the cost of e-commerce. The majority of supply trade transactions are now accomplished within stationary trade.

Q3

Although English is the predominant language used for international communication the wide-spread use of automatic translation systems allows less widely used languages to remain important.

Q5

Attractive mobile network services with mobile broadband technology for businesses and end users have become available on the market.

Q8

Reservations about ubiquitous computing are so considerable that its implementation on a large scale has not been possible. People perceive the increase in networking of their environment as a threat to their privacy (transparent consumer). Because of increasing security requirements, it is not commercially viable to equip all objects with the necessary processing power and communication modules.

Q9

World-wide introductions of norms and standards e.g. within the communication industry but also within classic technologies, are strived for.

Q12* The widespread support of communication technology has indeed created equal opportunities for all classes within society.
Q13 Security is such a dominant asset that people are open toward new surveillance and identification technologies.
Q16* The use of intelligent autonomous systems is restricted to the B2B sector (Prognosis of financial data, optimization of traffic flow, plant optimization).
Q17 Research groups and inventors develop new ideas on the basis of experience databases and trend prognosis. The knowledge gained remains intellectual property of the respective persons or companies. Human beings remain the driving force behind the innovation process.
Q19 Binary computing remains dominant, new generations of processors are still in development.
Q22 Central processing networks remain dominant, mainly for reasons of security and also to ensure full network coverage.
R2 Above all, ecologically aware consumers remain very sceptical about genetically modified food.
R3* Europe has found common ground with respect to jurisdiction and ethical considerations in relation to genetic engineering, which has given the industry legal assurance.

R6
Views on human society have led to a refusal to grant patent protection to any inventions relating to therapies or procedures involving human or animal life.
R7
There has been a debate on the right to have healthy children for a long time. In order to restrict the use of prenatal diagnostics exclusively to very serious illnesses and disabilities, numerous laws and regulations have been implemented.
R9*
Intensive public debate has led to clear opinions on the degree to which the use of biotechnology in health care is socially acceptable and consequently its use has become widespread.
R12
The great hopes attached to cell surgery have proved to be false. The challenges are greater than expected and it will take a further 20 years before a breakthrough can be reached.

Megatrends (MT)
MT1 Increasing globalism
MT2 Increasing age
MT3 Fewer children
MT4 Higher importance of women in the economy and society
MT5 Increasing mobility (“delocalization”)
MT6 Increasing stream of immigrants from outside Europe toward Europe
MT7 Increasing relevance of virtual communities
MT8 Half-life of technical knowledge
MT9 Increasingly networked communications media
MT10 Free choice of way of life

Descriptors – Scenario 2

Legend: ***Critical descriptors with high relevance for a positive future**
 Other critical descriptors
 Uncritical descriptors/megatrends

A1* Worldwide there are hardly any more trade restrictions. State-owned enterprises and public services within Europe are largely privatized and markets have been liberalized. The government is concentrating on a small number of central responsibilities.
A4 As a consequence of the interplay between communal, regional, national and European-wide levels there is a lack of clarity with regard to the assignment of responsibilities. Every query needs to be dealt with on at least two to three levels due to overlapping areas of responsibility.
A6 The government’s function is noticeably weaker than in the past. The government is ultimately unable to withstand international attacks by terrorists or hackers. Private agencies are increasingly employed in order to guarantee peace and order.
A8 Government, politicians and society are unable to generate the power necessary for fundamental reform.
A9 The dominance of the open market economy has led to a considerable increase of economic efficiency, social unrest and a neglect of public services.
B2 The nation state has successfully defended its position. A European foreign minister is in place, however, political decisions are still made within each nation state.

B3*
The UN is the central conciliation body for international conflicts. It is also financially independent and autonomous.
B6
European institutions still require majority consent of the respective nation states. Influence exerted by the European parliament is limited.
B7*
Large economic federations, such as EU, NAFTA, MERCOSUR etc. have gained considerable political influence.
B10*
There is an open world order from which Europe has not distanced itself, rather it draws energy from its common European history, culture and life-style.
C2
Religious communities fail to meet society's demand for a purpose in life. The majority of the public ignores religious communities and instead finds fulfilment in everyday life with its inherent values and claims.
C4*
Political parties have lost influence. They are hardly a factor in the forming of political opinion in Europe.
C5
NGOs represent a significant part of public opinion and are formally involved in decision processes.
C7*
Minorities, or the public, gain recognition and influence via citizen initiatives. They contribute to problem solving – mainly at regional level.

C10

Trade unions have been disintegrated by the particular interests of individual occupational groups and they have therefore been unable to focus their interests in a way to make them serious contenders for partnerships with enterprises or political parties.

C12

Business associations are a thing of the past. Businesses have learned that they are better off representing their own interests. Irrespective of their trade affiliations and size, innovative enterprises work together in networks.

C14

Decisions made by the public and citizens as well as direct elections of political positions play a major role.

D1

The media is a powerful force within society and thus influences decisions in the economy and politics.

D3

Freedom of the press is one of the most important assets within the international community. The press has a right to protection of sources and limited liability.

D6

The concentration of the media has led to a standardization of the provision of information, and more importantly, a standardization of the way in which major political and economic events are commented on.

D7

Everyone is free to disseminate their ideas, thoughts and works on the World Wide Web. The significance of institutional providers has diminished.

D10

It has not been possible to consolidate the western value of patent protection on a global scale. Copycats are frequently the economic winners with respect to innovation.

D12

A number of World Wide Webs have developed in parallel. As a consequence, innovative force, uncontrollable content and random diversification are on the increase.

E1*

Change within society is a value with positive connotations which expresses itself in the fact that individuals are open to change.

E4

There is a lack of clearly set out and universally binding moral values. Enterprises, organizations and individuals all equally strive for personal gain.

E5

Consumerism is a value in itself and serves as a measure of an individual's standing within society.

E7

Individual self-realization and the responsibility for one's own well-being are at the top of the hierarchy of values.

E9

The multi-cultural composition of society and its variety of lifestyles brings with it a range of ever-changing moral concepts.

E11

Everybody feels responsible for their own lives, development and personal actions. Assuming responsibility for your own actions, pro-active and entrepreneurial behaviour are recognized values.

E13*

People are open to the whole world, take the opportunity to travel everywhere and exchange ideas. Dealing with foreign cultures has become self-evident.

E16

National languages lose significance due to the widespread use of English as the common language.

E17
Status within society is determined largely by leisure activities and the participation in political life and society.
E19
Time has turned into a status symbol. “Time poor, money rich” rather than “time rich, money poor” is determining class distinctions.
E22*
The virtual world becomes an additional habitat besides others.
E24*
Quality and longevity are of more importance. Being cheap is not a value in itself, branded products play a relevant part.
E26
The government has not succeeded in guaranteeing public security. Therefore individuals invest big effort in this sector.
E27
Personal freedom and privacy are valuable assets. Protection of privacy is highly significant, any form of surveillance is rejected. There is no such thing as a “transparent consumer”.
F1
Individuals are free to choose their lifestyle. Society is tolerant and accepting toward the most diverse of lifestyles.
F4
The traditional concept of the family has lost relevance. Children and career are difficult to reconcile.
F6
In a society defined by performance and influence, the social divide continues to increase. The number of financially poor people is growing, many of them existing below minimal living wage.
F7
The low birthrate leads to an increased openness of European countries to welcome immigrants.

F10	Every generation takes steps in view of their own, personal risks.
F12	Regions situated in the south and east of Europe noticeably lag behind the general level of development.
F14	Urbanization has spread unhindered, rural areas are being deserted because it has become increasingly difficult to build a life there.
G2	Education is class-specific. A large number of people with an excellent education is facing an even greater number of people who are unskilled and “reluctant to be educated”.
G4	Not only educational targets but also educational institutions are competitive. A large number of experiments and continuous change are characteristic of the educational system.
G6	The awareness of the importance of education, with a view to development and contentment, has led to a massive increase in private expenditure on education.
G7	Businesses are aware of the importance of education for their future success and are therefore involved with their own educational institutions.
G10	A standardization of educational systems is advancing, but very slowly. The differences between degrees is one of the big factors inhibiting the merging of Europe.
H2	The public sector finances the majority of transport infrastructure.
H3*	Being available at any time at work or at home is taken for granted. People regard this availability as a basic commodity.

I1
Health is the most important value and status symbol in an ageing society. People are prepared to spend a considerable proportion of their income on it.
I4
Authorized by the respective law in force, people can decide on their life or death or they can transfer this decision to a loved one.
I5
Health research is guided by economic considerations. The general focus is mainly the wealthy market segment.
I7
The knowledge of different cultures has led to an acceptance of a wide variety of medical treatment methods (e.g. Eastern medicine, homeopathy or genetical practices).
I9
There is a considerable amount of private health care expenditure. All services within the health care system require additional individual contributions.
J1*
Europe is undergoing moderate but continuous economic growth, while the difference between the GNP of the individual countries has diminished considerably.
J3*
The European economy has managed to consistently improve productivity thanks to its advanced knowledge. This has secured Europe's position as center of industry.
J6*
The strong focus of businesses on quality and customer care, employee and supplier relationship management has led to high prices combined with high levels of service.

J7* Within the service sector, a high number of new, intelligent services (i.e. coaching) are developed which are increasingly required not only by businesses but also by individuals.
J9* Thanks to the economic growth and increase in gainful employment, the free disposable income has grown.
J12* Despite increasing self-financing for health care, retirement provisions and security, people manage to maintain their leeway for private consumption.
J13 Economic concentration has advanced. Apart from corporations acting on a global scale with a high degree of competitiveness in oligopolistic markets, there is an ever-increasing number of very small businesses.
J15 Increasingly, the services sector (tertiary sector) is gaining significance. Most new job vacancies are created from digital demand in information gathering, processing and distribution (quaternary sector).
K1 There is a flexible employment market in which every form of employment is possible. Businesses distinguish between core employees with fixed contracts and a peripheral workforce with flexible contracts.
K3 There is a wide variety of working-time models. Annual or lifelong working-time models allow for completely new ways of alternating between working and leisure time.
K5 Lifelong employment duration is rising as a consequence of the ever-rising age pyramid.

K8
The decrease of additional wage and tax costs makes shadow economies unattractive.
L2
Due to the considerable focus on shareholders, the short-term notice of economic actions continues to thrive.
L4
Innovation management is merely one of many topics in the field of management. Profitability of innovations is limited as profits are often skimmed off by copycats.
L6
There is a clear distinction between standardized or discount mass products on the one hand and luxury goods as well as goods of high specification on the other which are available in a few select markets only.
L7
The increasing uniformity of all products has turned the brand into the dominant distinguishing feature. Evidence of “Brand Equity” in company audits has become indispensable and can be compared on an international level.
L9
Businesses increasingly concentrate on their core abilities and outsource all other services.
L11
The relationship with customers, employees and suppliers is an important factor of competition.
L13
Recognition of the direct relationship between employee satisfaction and profitability of a company has turned human resources into an important factor and has resulted in the investment in further training.

M1
Technological impact on the environment is a relevant criterion in the decision-making process of enterprises.
M4
Verbally, the environment is an important value, however people are neither prepared to behave in an environmentally friendly manner, nor willing to spend more money on it.
M6
Every generation is its own best friend. The main focus is on those problems that need solving today. This means that topics with a solution requiring an intergenerational approach are not tackled.
M8
The continuously rising demand for resources has instigated a race among the major nations for the least expensive procurement of resources. Although resources continue to be available – but at a high price – there is a constant risk of shortages.
M10
The basis for political action is not so much the prevention as the management of problems which have surfaced already.
M12
The importance of the use of energy with a view to improving environmental quality and climatic protection has been recognized not only by the government and businesses, but also by individuals changing their behavior.
N1
Food is a valuable asset and only available in limited quantities outside of Europe. The struggle for world markets, the use of organic substances and poor distribution of food cause considerable shortages in certain regions.
N4
The price of food is very important. Whether it has been cultivated traditionally or organically remains a secondary concern.

N5
As with land, water supplies are increasingly privatized. Private enterprises act as operators, with the government acting as a supervisory authority.
O1
Society is marked by a wide openness toward new technologies.
O4
Safeguarding against major threats is left in the hands of private business up to a certain amount, beyond which the government steps in.
O5
The clearly defined role of regulators enables the privatization of primary supplies such as energy, telecommunications, postal services or water and thus prevents unjustified high prices.
P2
Fuel cell technology has still failed to achieve the expected breakthrough. Only in the stationary application are a small number of (subsidized) fuel cells already being used.
P4
Large power plants linked via grid systems form the backbone of energy generation in Europe.
P5
Generation of electricity through nuclear power at competitive prices and technological developments of inherently safe nuclear power plants as well as the avoidance of CO ₂ emissions has led to a revitalization of nuclear power and the acceptance of ultimate waste disposal.
P7
Due to economic growth and increase in population, energy requirements have grown considerably. Light, heat and power have become more vital in an increasingly technological society.

Q1* e-commerce is one of the most important distribution channels. Electronic purchasing of goods and services, payments but also logistic disposition within the supply trade are now the norm. Within the experience trade e-commerce and stationary trade supplement each other.
Q4 The predominance of world languages and mainly the English language is such that the number of people (willing to) work with automatic translation systems is very small.
Q5 Attractive mobile network services with mobile broadband technology for businesses and end users have become available on the market.
Q7 Ubiquitous computing has established itself. Objects that are used in daily life and in the workplace are intelligent and networked. Information about location condition of these objects is used to optimize production and delivery processes and to improve comfort.
Q9 World-wide introductions of norms and standards e.g. within the communication industry but also within classic technologies, are strived for.
Q11 The class factor use/access to electronic means of communication divides world citizens, the informed, the employed and the young with good start prospects from the part of the population that has no access to such opportunities.
Q13 Security is such a dominant asset that people are open toward new surveillance and identification technologies.
Q15 Intelligent autonomous systems fulfill a number of tasks in private and working life (disposition of consumables, automatic security features...).

Q17

Research groups and inventors develop new ideas on the basis of experience databases and trend prognosis. The knowledge gained remains intellectual property of the respective persons or companies. Human beings remain the driving force behind the innovation process.

Q20

Binary computing remains dominant, new generations of processors are still in development.

Q21

Self-organizing networks have strongly increased. Thereby the end user stations serve as nodal points. Exchange of data and telephone calls are effected without the use of central processing networks.

R1

Genetically modified food has managed to slowly establish itself despite carrying clearly marked labels.

R4

Views on what is permitted or prohibited according to the Geneva conventions are strongly divided within Europe.

R5

Considerable developments for the use of human respective animal components have been patented. Enterprises hold the rights to certain therapies and possible procedures.

R8

All technologies that allow influencing human life before birth are being used. Technologies such as in vitro fertilization – originally intended to enable childless parents to conceive – enable to at least some degree the realization of individual wishes, applying certain selection criteria.

R10

Every country has its own conception of what procedures are legal or illegal. Patients hoping to be cured by specific methods frequently travel abroad to legally undergo therapies in use locally.

R11

Today cell surgery is taken seriously as a medical procedure and living proof for the successful combination of the most diverse of technologies to the population's advantage. Illnesses for which previously no cure could be found can now be cured.

Megatrends (MT)

MT1

Increasing globalism

MT2

Increasing age

MT3

Fewer children

MT4

Higher importance of women in the economy and society

MT5

Increasing mobility ("delocalization")

MT6

Increasing stream of immigrants from outside Europe toward Europe

MT7

Increasing relevance of virtual communities

MT8

Half-life of technical knowledge

MT9

Increasingly networked communications media

MT10

Free choice of way of life

5.4 Glossary

Amorphousness:	Formlessness, lack of structure.
Augmented reality:	Reality enriched by computer technology, e.g., a live TV broadcast enhanced with computer simulations.
B2B:	The business-to-business sector.
B2C:	The business-to-consumer sector.
Bologna process:	In June 1999, the education ministers of 29 European states signed the Bologna Declaration in which they agreed to create the European Higher Education Area by the year 2010 and to make Europe's university system more competitive worldwide.
Consumist:	A post-modern successor term for consumer, used to denote the never-satisfied consumer, constantly eager to purchase all kinds of products and services.
Cosmeceuticals:	A portmanteau word formed from cosmetics and pharmaceuticals to describe foods that improve people's appearance, e.g., yogurt enriched with vitamin B complex for shiny hair and strong fingernails.
Culturetainment:	A portmanteau word formed from culture and entertainment, used to describe cultural events with an extravagant quality.
Domotics:	A portmanteau word formed from domus (Latin for home) and robotics, describing a field of technology devoted to networking and remotely controlling domestic appliances.

E-clans, e-clanning:	Groups of people who have met each other on the Internet and have formed close networks similar to clans.
E-tags:	Electronic product labels that contain a range of information, for example the price, use-by date and details of the product's composition.
Europas 35:	Expansion of today's EU by an additional 10 countries.
Fuzzy society:	An amorphous society characterized by a wide diversity of groupings and frequently short-lived social networks.
Gray surfers:	The 50-70-year-old generation of Internet users, an important and wealthy target group for advertisers.
High touch:	A term used to describe highly personalized "face-to-face" services. High-touch services are services involving a particularly intensive, individualized customer relationship.
Homing:	A fondness of spending leisure time within your own four walls and inviting guests home.
Hybridization:	The blurring of distinctions between gender roles.
I-blog:	A public internet diary that provides a facility for readers to add comments. Originally, diary software developed by Apple Computers.
Information fatigue syndrome:	Lack of concentration and permanent tiredness brought on by information overload.

Interac-table:	A communication system integrated into a table (with internet access, TV etc.).
Lab-on-a-chip:	A mobile mini-lab used to carry out instant analyses of, say, blood values in doctors' offices.
MMS advertising:	Multimedia advertising, e.g., in the form of mobile phone advertising.
M-payment:	A system that allows consumers to pay for goods and services using a mobile phone.
NGOs:	Non-governmental organizations (e.g., Greenpeace, Amnesty International).
Passive energy house:	A design of house introduced in 1991, largely capable of heating itself thanks to sophisticated heat insulation.
POS/point-of-sale:	The physical location where goods are sold to customers.
Prosumer:	A consumer who is actively involved in product design – for example, one who specifies important details to be incorporated into a product during its manufacture.
Sanity foods:	Foods partially enriched with pharmaceuticals to foster good health (e.g., yogurt containing headache medication).
Smart mobs:	U.S. Internet pioneer Howard Rheingold, who in the early 1990s did more to promote the concept of the virtual community than anyone else, goes one step further in his new book, Smart Mobs. In it he explains how mobile communication technology and always-on internet connections amplify human talents for co-

operation, causing virtual communities to spill over into real life as smart mobs. Using mobile phones, the Internet and PCs, these groups can organize and coordinate their actions quickly and easily.

Supranet:	An overarching network that melds intranets, extranets and the Internet to integrate all forms of communication.
Telematics:	The integrated use of telecommunications and computer technology.
Tertiary sector:	The services sector within a national economy.
Thematic theater:	A form of theater in which a specific theme is addressed in a specially created dramatic work or is illuminated from different perspectives in scenes taken from a number of different works.
Third place:	A public place in which people socialize, e.g., a community center, club, etc.
Track-your-kid-technology:	Technology that keeps parents informed at all times about their children's whereabouts. For example, children can be tagged with an armband containing a chip that reports their location to a monitoring system.
Ubiquitous computing:	A concept in which everyday objects are equipped with information technology and computing capabilities.
Ubiquitous working:	A concept in which information and communication networks have attained such a scale that people have the flexibility to work anywhere, anytime.

Web log:

A personal journal published on the Internet in which a person comments on recent events or expresses their own thoughts and ideas. Web logs are comparable to news pages but are more selective and personal in scope. They can offer an important complement to online news media as they tend to respond more quickly to trends and offer further information and links to specific topics.

WLAN:

A wireless local area network. WLANs are used to provide mobile internet access.