

NO.15 MAY 2011

/Java; what's next?

\*technology

/Falcon electron detection camera

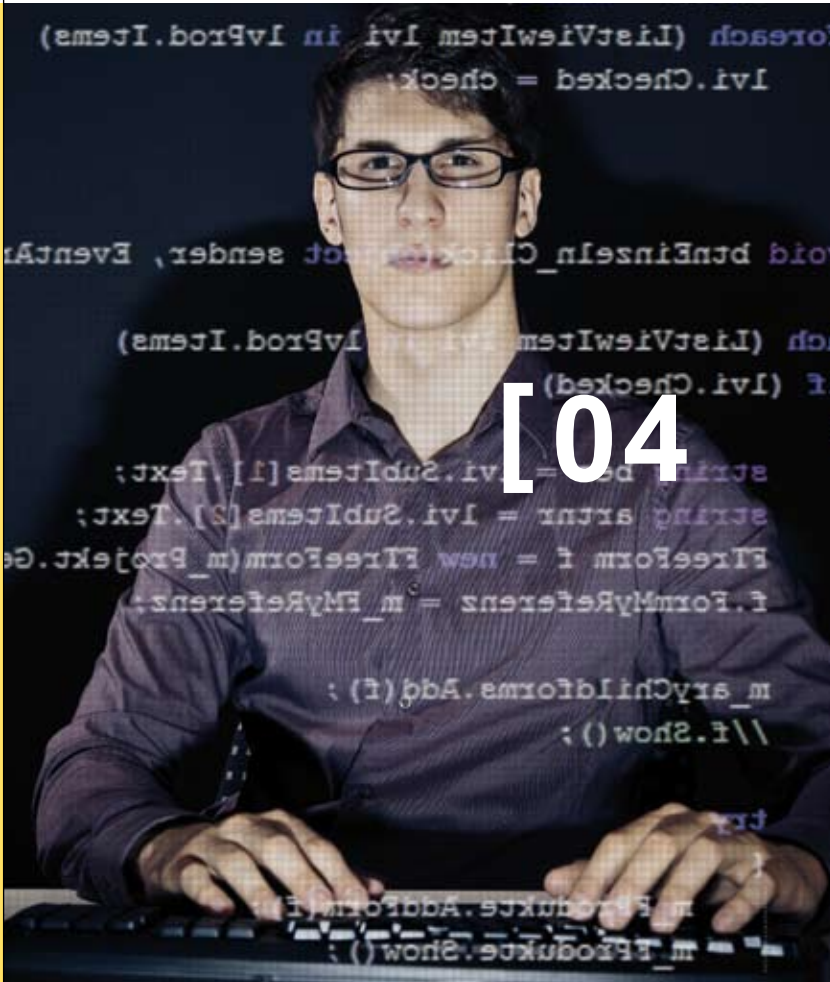
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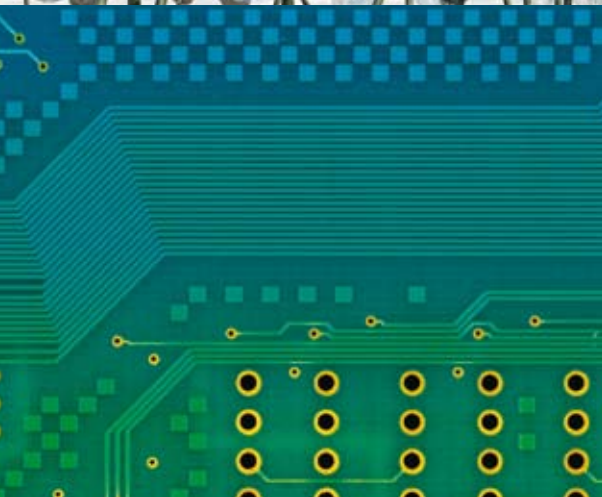
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Jan van der Wel

CEO



## /foreword

**The price of oil continues to rise, and may well reach a level as high as \$250 per barrel. It is said that the upheaval in the Arabic world is the cause. However, could there be another explanation? After all, the supply of fossil fuels, such as coal, oil and natural gas, is finite, and not only are these fuels becoming more difficult to source, but developing nations are consuming more and more of these stocks.**

Alternative energy sources are one solution, but every alternative energy has its own limitations. For example, bioethanol production takes up farmland that could otherwise be used for food. Wind energy is only available on windy days, and solar power is only available during daylight hours. Nuclear energy involves major risks, as we have all witnessed in Japan in recent times. In short, there's no such thing as a perfect energy source and we will have to combine different forms of energy in order to satisfy our growing energy needs.

## >>there's no such thing as a perfect energy source

A good example of developments in this field is the electric car. Cars nowadays are overwhelmingly powered by oil-based products. However, these fuel sources will not last forever. Will the future see us driving fuel-cell-powered cars that generate electricity from hydrogen-rich raw materials, or cars powered by batteries charged at home or at a recharge point? Eventually, car engines will be powered by electricity. The power source for these engines is not yet known, but one thing that is certain is that electricity will eventually become the uniform source of energy.

One disadvantage of electric power is that it cannot be stored. This makes it extremely important that suppliers meticulously co-ordinate supply and demand. After all, the more electricity we use, the more electricity needs to be made available. For this reason, energy companies and distribution network operators are placing a great deal of emphasis on investigating possible energy storage and energy management techniques. In this edition of Objective, we will inform you of energy-related technological innovations, the Dutch distribution network operator Enexis will reveal their methods, and we will tell you more about our vision of smart networks.

**Happy reading!**

/technology

# Java; what's next?

>>the wonderful world of programming languages

**Programming languages are programmers' essential tools. These languages are undergoing constant evolution. They have to continually improve in order to allow programs to be written more quickly and efficiently and to allow mistakes to be detected beforehand. However, is every new language an improvement? And when should you switch to a new programming language?**

Every year, processors get considerably faster. Faster computers enable software to do more for us, and programming languages provide the tools to create this software. These languages are evolving all the time, and the rapid flow of new programming languages allows programmers to work more efficiently. New computing languages are not created out of thin air. Although they often contain new elements, they always use tried and tested

elements of previous languages.

If the languages are somewhat similar, then the learning process is made simpler. However, if they are practically alike, no progress is made. This conundrum forces the users of these languages to make strategic choices, i.e. do we keep using the current language or do we switch to a new language? A new language may offer more efficient working methods, but it takes effort to learn and you have to hope that the rest of the world follows your lead.

## Evolution

Programming languages have been changing since the very first language was developed. The first languages were linear. In the Basic dialects, you programmed on a line-by-line basis, with loops and jumps to other parts of the code. Subsequently, more user-friendly languages were created such as Pascal and C. Languages of this type are called imperative or procedural languages. Within the academic world, there is another trend: functional languages such as Lisp and Haskell. The key focus of these languages is functionality. However, these functional languages have never been very popular in the industrial sector.

One of the most major innovations was the step from imperative languages to object-oriented (OO) languages. Smalltalk is the

Functional Programming	Haskell / Clojure / F#	
	Scala	Ruby Python
Object Oriented Programming	C#	
	Java	Smalltalk
	Statically Typed	Dynamically Typed

```

switch(Label)
{
    case eNodeLabel.Amount:
        g.FillRectangle(BrushGray, new Rectangle(RectPercent.Width * Bau..
        string strperc = Bau.HybridAnzahl * 100.05;
        g.DrawString(strperc, MainFont, BrushBlack, RectPercent.Width * 0.5,
        break;
    case eNodeLabel.Amount:
        g.FillRectangle(BrushGray, RectPercent);
        string stram = Bau.Kombiniert.ToString();

        foreach(int hyb in Bau.HybridAnzahl)
            stram += (" "+hyb.ToString());

        g.DrawString(stram, MainFont, BrushBlack, RectPercent.Width * 0.5,
        break;
    case eNodeLabel.None:
    default:
        g.FillRectangle(BrushGray, RectPercent);
        break;
}

```

mother of the OO languages, although it was C++ that made this trend famous. Java is an language that is now extremely widely used, although the language alone is part of a greater whole: the Java platform. This is a trinity of the Java language, the Java Virtual Machine and the Java libraries.

### Java language

The origins of Java date back to the 1990s, when hardware performance was a major issue. In order to get the very best performance whilst simultaneously making the step to the (then) new language as straightforward as possible, some concessions were made when developing the languages. Java is therefore not a pure, object-oriented language like Smalltalk: it is not all one entity. This results in ambiguity and exceptions in the language.

### Java Virtual Machine (JVM)

The application of a virtual machine is one of the Java platform's most important innovations. During the creation of C, program code is generated in machine code for a specific processor. In order to be used by another processor, the C program has to be recompiled for this new processor. When compiling Java, the program is generated in bytecode. Bytecode is not run directly by a processor, but by a software layer: the JVM. The JVM is typically written in C and compiled for a specific processor. This means that as long as a JVM is available, a Java program can be run on any system (hence the slogan 'write once, run anywhere'). Furthermore, the JVM is an ideal processor that greatly simplifies programming. Important contributing factors to this include straightforward memory management and the ability to remove many types of errors by means of stringent checks during compilation and running.anywhere). Daarnaast doet de JVM zich voor als een ideale processor en vereenvoudigt het programmeerwerk.



## Scala:

```
case class Clock (var hour:
Int, var min: Int);
```

## Java:

```
public class Clock {
    private int hour;
    private int min;

    public Clock(int hour,
int min) {
        this.hour = hour;
        this.min = min;
    }

    public int getHour() {
        return hour;
    }

    public void setHour(int
hour) {
        this.hour = hour;
    }

    public int getMin() {
        return min;
    }

    public void setMin(int
min) {
        this.min = min;
    }

    public String toString() {
        ...
    }

    public boolean
equals(Object arg1) {
```

## Java libraries

For the sake of productivity, it is also important that libraries are available. Libraries contain existing codes written by others. Popular languages may feature countless megabytes of existing code, to which you need add just a couple of lines to create, for example, a website. The library is therefore an important factor in deciding which programming language to use. Java has been around for over ten years, and in this time, a great number of libraries have been developed for Java. The Java code is mainly freely available from these libraries (open source).

## >>every language has its own life cycle

### Development environment

In addition to the Java platform, the development environment is also vital to productivity. They are known as 'Integrated Development Environments' (or IDEs). For Java, a number of these are available, with Eclipse being the most well-known. The IDE gives the programmer a great deal of support during programming. For example, it checks that the code is correct during input, and contains in-built debugging tools and links to libraries.

### Law of the handicap of a head start

The degree of innovation in a programming language is inversely proportional to the age of the language and the number of users. Software products written in a language that is already in use require backwards compatibility. This is an aspect that former Java owner Sun has always paid a great deal of attention to. However, this slows the momentum of the innovation, eventually to the point that it stops altogether. When this occurs, it is time to look for a new language. This life cycle applies to all programming languages.

### What's next?

The last few years have seen a constant flow of new programming languages. A number of these languages build on what was already available, and take advantage of the JVM and its associated benefits. Examples of this are Ruby, Python and Groovy, which in general create much more compact code than Java. Furthermore, innovations in these languages are implemented like closures, with functions being write out where necessary. For minor functions, this saves a great deal of typing. For years now, the Java community has been gathering information on how to incorporate this into the structure of Java.

An important disadvantage of the above-mentioned new languages is that they are all based on 'dynamic typing'. This means that errors are only discovered when the program is run. These languages are therefore not suitable for creating complex programs in large teams. It is therefore important that your compiler provides optimal assistance in detecting possible errors in the program before it is run.

## Scala

One exception is the new language Scala. The person behind this language is Martin Odersky, professor at the University of Lausanne (EPFL) and an important figure in the development of Generics, one of the latest Java innovations. Scala programs are run on the JVM and can make use of the existing Java libraries. Scala is a programming language that is relatively high in innovation. It is a hybrid language that combines both OO and functional concepts. This method has now become a trend, with even Microsoft making use of it in the .NET platform by means of LINQ. Without going into too much detail, LINQ relies quite heavily on the style of the functional languages.

A further important factor is that Scala makes use of static typing. This means that the compiler is particularly strict, which helps to prevent a large number of errors. One noticeable innovation is 'type inference'. This means that programmers do not always have to explicitly repeat the types of variables and parameters, and as a result, the code is more compact. If possible, the compiler itself should specify the types. The scientific idea behind the determination of the types by the compiler is also based on the functional style. Traits are another innovation. These are Java interfaces in which implementation (fields and code) is permitted. Traits can help eradicate restrictions of single inheritance.

The Scala community is growing rapidly and has developed an IDE for Eclipse that is already working relatively well. Scala therefore has all of the ingredients to be a potential successor to Java...or does it?

## Barrier

In general, Scala would seem to have all the right stuff. However, it is not quite ready to take over the world. For most users, the language barrier is too high as the many innovations that the Scala language incorporates means that it differs greatly from Java. This is often the case during the transfer to a new language. Investment is required before the benefits of improved productivity can be realised. The IDE also works adequately, but it is not yet as user-friendly as Java.

Furthermore, the Java community seems to be burying its heads in the sand somewhat, and would rather spend another year discussing new improvements to the language. However, it is likely that this has more to do with political matters rather than innovations in the language.

As long as major businesses do not adopt the new language, Scala will remain a niche product, although a business such as Google could give Scala the extra weight needed to tip the balance. The search giant has often shown that it has the courage to try something new. Scala has already been accepted in the Google Summer of Code programme, which sponsors university students to work on promising projects.

It is essential that Technolution continues to monitor the field of programming languages, as it allows us to separate the wheat from the chaff and to always know which horse to bet on and when. Only one thing is certain: one day, Java will once again be just the name of a coffee-producing island in the Indian Ocean...



## /vision

# From energy user to energy producer

## >>technical innovations bring about change in the energy market

**Many different pictures have been painted of the electricity network of tomorrow. Recently, there has been a great deal of discussion about decentralised generation of electricity, and electric cars frequently make the headlines. In order to make this possible, a smart energy grid is required. This shows that there has been a great deal of development in the energy market within a short time. But where are these developments taking us?**

Electricity plays a major role in our society, and it is only going to increase in importance, for example, with the rise of electric cars. The supply of fossil fuels is finite, so eventually, we will be forced to switch to engines powered by alternative fuel sources such as electricity. However, the electrical grid will have to be adapted in order to prevent overloading when everybody gets home from work and plugs their car into the mains! All of these car batteries offer an enormous amount of capacity in which temporary electricity surpluses can be stored, although the electrical grid must be adapted to handle this. After all, electricity follows the path of least resistance. The electricity travels through the network in one direction only: from the power station to the end user. A smart electricity grid sends the power in whatever direction is required: from the power station to your plug, from a solar panel to a regional power station or from a CHP boiler to the battery of your electric car. This way, if there is a shortage of electricity or the network is in danger of overloading, then you can power your house via electric-car batteries or electricity that is generated and stored regionally. In this way, electric-car batteries become part of the electricity grid.

### **Smart grids: everyone has their own vision**

This is just one of the many visions of a 'smart grid': the name given to the electricity grid of the future. However, nobody can say exactly what a smart grid will actually entail. Everybody has their

own interpretation. For a distribution network operator, the smart grid will be a tool for realising more efficient use of the network. This will prevent major investment in the laying of new cables. Electricity suppliers produce electricity and sell it to the client. For these companies, the smart grid offers extra opportunities to sell electricity to clients, for example, via car-recharge points. It will also mean that energy consumers will also increasingly become energy providers by means of solar panels, CHP boilers etc. This group also has its own vision of the smart grid.

### **Energy management**

The managers of the electricity grid will have to anticipate the increasing fluctuations in supply and demand. The rise of electric cars, cogeneration, batteries, solar panels and CHP boilers will necessitate drastic changes to the electrical grid and the way it is managed, as electricity will be heading in all directions! Furthermore, wind and solar energy ensures that the range of electricity on offer is very varied. When the supply is too great, the grid can overload, with the regional transformer being the first to fail. A battery may help to reduce the burden on these regional stations.

This is exactly the idea that is being tested in the Dutch city of Etten-Leur, where eighty houses equipped with solar panels generate 200 kWh per day. In addition to the panels, an enormous battery has been installed to measure whether or not surplus electricity has been produced. The battery serves as a buffer: it can store surplus power generated by the solar panels, and if regional demand for electricity at peak hours is greater than the distribution network operator is capable of supplying, then the battery can step in to make up the deficit. Furthermore, residents can programme their smart washing machines to only operate if enough power has been generated by their solar panels. Etten-Leur therefore has a regional smart grid.

### Traffic management in the electrical network

The programming of appliances to depend on the capacity of the electrical grid is almost like ramp metering on motorways. This draws comparisons between the electrical network and the road network, and makes the goal of grid management the same light as that of traffic management: to ensure that demand and capacity remain in balance.

One important factor is the ability to predict the demand for electricity. Distribution network operators currently use models that estimate the power consumption of each 24-hour period. However, in a smart grid, with decentralised generation and hungry power-guzzlers such as electric cars, a much more accurate method of prediction will be required, especially if the number of electric cars rises. However, the measurement and management equipment necessary to do so is not yet available. This equipment will be provided in the form of an ICT network running parallel with the electricity network, intrinsically combining the two in order to anticipate all energy-related developments.

### Internet of energy

This gives rise to comparisons with another vast network: the Internet. This similarity has been recognised by the EU, a fact demonstrated by the EU research programme 'Internet of Energy', which Technolution is participating in. This initiative is investigating whether the European energy network can be set up in a way similar to the Internet: as a flexible network with links between energy producers, suppliers and users that allow the exchange of information about energy consumption, supplies, production and costs within a secure network. An Internet of energy would also require adjustments to current equipment. These would require additional devices to enable remote measurement and management. As part of the EU project, the consortium is striving to create standards for the connection of domestic electrical equipment to the network. These connections will enable measurement of energy consumption or the number of kilowatt hours generated by solar panels. This gives consumers insight into the energy consumption/production of every device, which in turn makes them more aware of their behaviour and the effect that it has on both the environment and their bank balance. This is another vision of the smart grid.

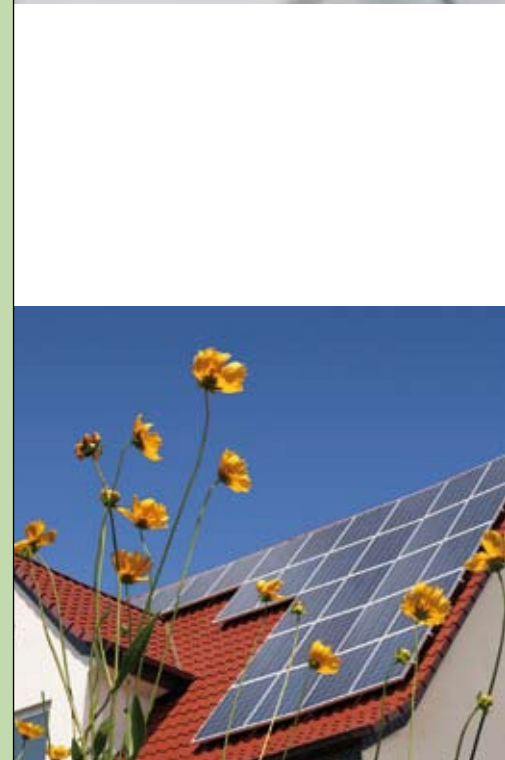
### Role of the government

The government can encourage initiatives by granting subsidies. One example of this is the Stichting E-laad (the E-Charge Foundation) in The Netherlands, which involves distribution network operators setting up charging points for electric cars. The EU subsidises research projects aimed at creating a European market. This allows the creation of European standards, enabling European businesses to develop the knowledge themselves rather than being dependent on other standards.

However, legislation is a much more important factor. By granting concessions, the government is able to set environmental standards for regional and group transport. Municipal governments can give incentives to the logistics sector by establishing urban green zones within which shops must be supplied by electric delivery vehicles. This will cut down on both noise and air pollution. Many businesses have already anticipated these trends, working with electric lorries and vans which inductively recharge at the parking areas and unloading points.

### First life cycle of smart grid

As you can see, the exact structure of the smart grid is not yet clear. What is certain is that it will link three markets: energy, transport and finance. These are markets in which Technolution has an extensive amount of professional knowledge and expertise. The smart grid is currently in the exploratory phase. No standards are yet in place, although they are on the way. This is the time to build prototypes, test concepts and investigate the best structure for the smart grid.



/case

# The search for the ultimate picture

>>the Falcon electron detection camera

**Biological matter is difficult to investigate with electron microscopes. It has very little contrast and deteriorates under the influence of electrons. However, a new type of sensor enables smaller amounts of electrons to be used, enabling more information to be obtained before the sample deteriorates. Based on this sensor, Technolution has developed a new camera for microscope manufacturer FEI.**

FEI is a world leader in the manufacture of high-end electron microscopes. Using transmission electron microscopes (TEM), it is possible to distinguish details that are less than one Ångström (10-10m) in size. These microscopes are used in the electronics industry, the biomedical sector and research institutions.

In a TEM, the electrons pass through the slide just like the light in an ordinary (light) microscope or slide projector. Electromagnetic lenses enlarge the beam and focus the slide onto a camera which sends the images to a PC.

Biological matter displays very little contrast in a TEM and deteriorates rapidly when subjected to electron radiation. In biological research, low doses of electrons are preferred, although with conventional cameras, this results in a poor signal-to-interference ratio and low resolution. For this reason, FEI has ordered the design of a more sensitive CMOS sensor in order to directly detect electrons.

## **From sensor to direct detection**

In conventional TEM cameras, a scintillator converts the electrons into light which is then registered by the sensor. This conversion process is necessary to protect the sensor from the electrons, although it results in inefficiency and lower resolution. The new sensor has been specially designed to reduce the influence of direct lighting with electrons, making it much more sensitive. As a result, with the same quantity of electrons, you can create three times as many images that are equal in quality to those of regular sensors. Equally, you can use one-third of the usual quantity of

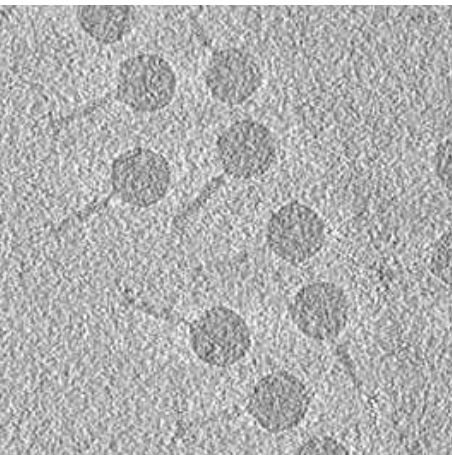
electrons to create the same amount of images as with a regular sensor.

## **From sensor to camera**

A sensor is not the same as a camera. The key to turning a sensor into a camera is signal processing. However, the right casing is also important. The sensor is a large 16 megapixel silicon chip, provided on a printed circuit board which must fit completely into the TEM's existing sensor chamber. The physical space available for electronics is therefore extremely limited. By wire bonding the sensor directly onto the print, the space is used far more efficiently. Furthermore, the high vacuum in the sensor chamber demands careful design of the printed circuit board in order to prevent contamination of the vacuum. Furthermore, it must be possible to extract the sensor from the sensor chamber in order to make room for a second camera: this requires flexible PCB technology. And of course, strict requirements also exist regarding transmission of the sensor output. In order to comply with these requirements, simulations and field-solving techniques are employed which analyse and optimise the function of the analogue signal pad..

## **Vacuum and cooling**

As mentioned earlier, electron microscopes work in high vacuums, which results in additional technical challenges. The electron microscope works in a high vacuum to prevent scattering of the electron beam. The sensor is also located in the vacuum, which makes cooling a challenge. Cooling is necessary to improve the signal-to-interference ratio. The sensor is cooled using a Peltier



element, and the heat is conducted away by water.

Due to the limited cooling and space, the necessary electronics must be kept out of the vacuum as much as possible. The camera is read out on a vacuum-compatible printed circuit board. The raw image data is transmitted directly through the vacuum chamber, whereupon it is digitised and transmitted from the camera via a 10GB fibre-optic cable. The cable carries the data to an external processing unit, which processes the image.

#### **Image processing**

Each pixel is calibrated separately with regard to offset and gain. With such a large chip (4K x 4K = 16 megapixels), the chances of defective pixels are high. However, the software can compensate for this. The algorithms are run by the TEM software installed on the operator's PC. Ultimately, the operator decides which settings are used. Due to the large volume of pixel data, it is not possible to run these algorithms on a standard PC. These algorithms are therefore run in a separate processing unit. The processing unit reduces the 10GB data flow in order to make it compatible for PC use. The processing unit is connected to FEI's PC via a standard 1GB Ethernet connection, and this PC operates a software module that communicates with both the processing unit and the PC's own software.

#### **New experiences**

It was a new experience for Technolution to fundamentally examine the physics and technology at such an early stage in the product's development. We not only investigated how the sensor worked, but also the entire TEM technology that surrounded it. The project was particularly interesting as we investigated complex questions on the cutting-edge of modern innovation, such as how the components and factors such as electron radiation, X-rays, vacuums and vibrations affect one another, and how the design can be optimised within the constraints of this environment. In order to develop and manufacture the mechanics (the camera casing), Technolution worked together with Demcon. Technolution played the lead role in the project, developing the electronics, the software and the programmable logic. We also created a life-cycle-management plan to ensure that the new camera remains properly maintained for years to come.

The complete picture is important to FEI, and as such, they have maintained intensive contact with their clients in order to monitor their needs and desires. And with the new electron detection camera, the company has a powerful tool to further optimise the service they provide to their customers.



/customer interview

# Enexis;

## anything for a reliable network

**Distribution network operators (DNOs) are responsible for maintenance and expansion of the electrical grid.**

**Maximum usage of this expensive infrastructure**

**accounts for only a small fraction of each day. As a**

**result of new developments, greater demands will be**

**put on the grid at peak hours. In order to prevent**

**unnecessary investment in extra grip capacity, DNOs**

**are interested in creating a smart grid in order to**

**maximise the efficiency of the network. In order to**

**gain experience with a smart grid, Dutch distribution**

**network operator Enexis is currently conducting trials**

**with electric cars and energy storage.**

Enexis operates the gas and electricity distribution networks in the Dutch provinces of Limburg, Noord-Brabant, Groningen, Drenthe, Overijssel, and parts of Friesland and Flevoland. The business provides 2.6 million households and businesses with electricity, and 1.8 million with gas. Enexis also operates the section of the electrical network from the high-voltage electricity grid to your electric meter. This network will witness major changes in the coming years. Soon, people will be generating electricity at home by means of solar panels and CHP boilers. However, we will also be using far more electricity as society switches to the electric car.

“When you generate electricity, it has to be used straight away”, explained Danny Geldtmeijer, innovator at Enexis. “And conversely, if you need electricity, someone has to generate it straight away. You can’t stock up on electricity. You have only a few milliseconds of flexibility, after which the energy is lost if not handled correctly.”

### **Predictable**

Fortunately, human behaviour is relatively predictable. In the evening, we put the dishwasher on, make coffee and watch TV. As Geldtmeijer explains, electricity producers and distribution network operators make predictions with regard to energy consumption. “TenneT, the operator of the high-voltage grid in The Netherlands and parts of Germany, monitors activity during the day. They have a reserve capacity to cope with any unexpected deviations. Furthermore, power stations never operate at full capacity. Every power station can, if necessary, increase or decrease production in order to exactly satisfy the demand.”

### **Smarter or more capacious network?**

In the future, use of electricity will become less predictable due to the use of electric cars, windmills and solar panels. The supply and demand of electricity will fluctuate greatly. Geldtmeijer explains that this is the reason for Enexis’s focus on the electric car. “If electrically powered transport makes a serious breakthrough (a few dozen percent), then we may have to increase the capacity of the grid. This will necessitate either pavements being torn up and thousands of kilometres of new cables being laid, or smarter use of the current grid. Smarter use of the grid is more than feasible as is only in the evening that the grid operates at maximum capacity. At all other times, a large percentage of the network remains unused. In off-peak hours, there is plenty of free space to transport energy. We therefore want to use the grid more intelligently, spreading out the capacity. If you can do that, then smart grids will naturally follow.”

Smart grids such as this are also essential for the purposes of sustainable energy. Windmills, for example, can only generate electricity when there is wind – they cannot simply provide electricity upon demand. Furthermore, we use more energy in the evenings, while solar panels only work during daylight hours. Enexis sees the electric car as being a solution to this problem. “The batteries of electric cars can be used to store electricity surpluses from windmills and solar panels. This way, when the demand for electricity exceeds the capacity of the grid, you will be able to use this electricity as a back-up supply.”

### Electric cars

There are plenty of ideas, but how do you make them work in practice? To investigate this matter, Enexis converted 15 Volkswagen Golf station wagons to run entirely on electricity. The company also provided knowledge and expertise in the field of battery charging. A large car was deliberately chosen for this trial. "The first fully electric cars were small two-person vehicles and sports cars, which the average car driver cannot relate to. This was the reason for selecting a family car. We want to know how an electric car such as this will be received. Will people use them for work? How likely is it that they will catch on with consumers? What will people do with them? To find answers to these questions, we will monitor their driving habits and the amount of electricity they use. This will give us an idea of the future demand on the electrical grid."

### Flexibility

Enexis only creates conceptual designs. They then look for a company with the expertise required to realise the necessary technological solutions. "We were looking for a combination of hardware and software, which suited Technolution perfectly. Technolution also offered a great deal of flexibility. We embarked on a collaboration based on a set concept. We have a mutual understanding, and throughout the process it will become gradually more and more clear what the result will be. Technolution offers a level of enterprise and expertise that ensures that the company always lands on its feet."

During the first investigation, Technolution developed the MobiBoxx and sensors to measure the energy consumption and efficiency of the electric cars. The second project addressed how to quickly and intelligently charge the cars. "You simply plug the car into the recharge point. Via an app on your mobile phone, you can indicate what time you next want to drive the car and how far you want to travel. The underlying system then calculates the best time to charge all of the cars connected to the system, and the optimal intensity of current."

### Enexis and the smart grid

According to Geldtmeijer, there is not yet a simple definition of what a 'smart grid' is. "At this stage, we are mainly discussing its functionality. The key concept behind the smart grid is the availability of information and intelligent usage of this information. Smart equipment can be developed, such as washing machines that only start when a surplus of electricity is available from the solar panels or another energy source. You have to add an information network to the electrical network in order to measure the network usage and manage it more efficiently. For example, notifications can be issued such as 'cut back for now, because later it will be much cheaper'. However, it will be a few years before any large-scale plans are realised."

The central issue is money. "Looking to the future, we have a choice: spend tens of billions of euros laying new cables or a few billion euros to realise a smart grid and avoid unnecessary investment. Will consumers be willing to be more flexible if supported by a smart grid? Can we continue to develop technology that allows consumers to enjoy all the comforts of modern life? Will they be prepared to pay more? Once we have answers to these questions, we will be well prepared to anticipate the demands of the market, and our joint projects with Technolution are helping to find answers to these questions."

Watch the video 'Praten met de auto' (talking to the car), in which Danny Geldtmeijer explains the electric-car trials in his own words.

The commentary is in Dutch, but the pictures will tell the story!

<http://www.youtube.com/EnexisSlim>

YouTube



**Danny Geldtmeijer,**  
innovator at Enexis



/trends & hypes

# Seals of approval for software: a trend or hype?

>>validation needed in addition to verification

**Anyone who commissions the development of software expects to receive a functional system. However, once delivered, how can you tell whether or not a system is of the required quality? A seal of approval can provide assurance in this situation. How exactly is software developed and what does a software seal of approval verify?**

Nowadays, development and production of custom-made software is being increasingly outsourced. These are often major projects, involving complex systems for the banking sector, hospitals, traffic management etc. Once a concrete investment has been made and the end product delivered, the client needs to know that the software functions properly. The system will then undergo many years of use and maintenance. Eventually, new wishes and requirements may arise, necessitating the addition of extra functions. If the software has been properly developed, then it is a relatively simple task to add extra functions. In order to do this, the code must be clear, unambiguous and well-structured, not just to the writer of the code, but also to the other developers. To illustrate the point, if a house is well built, you should be able to add an extra wall to one of the rooms without the entire house collapsing!

## Tools

The maintainability of the software is largely determined by the style and structure of the software. Separate functions must be recognisable and easily adjustable without influencing any other functions. Fortunately, there are tools that help to write clear code. In the same way that grammar and style guides provide guidelines for language, rules and agreements provide guidelines for compiling code. These rules and agreements have been worked into special code-analysis programs such as Klockwork and Lint. These tools monitor the code for typical pitfalls: "I understand what the code has to do. You have made a cupboard with 10 shelves but you are trying to put something on shelf 11. Something is wrong, and you need to do something about it."

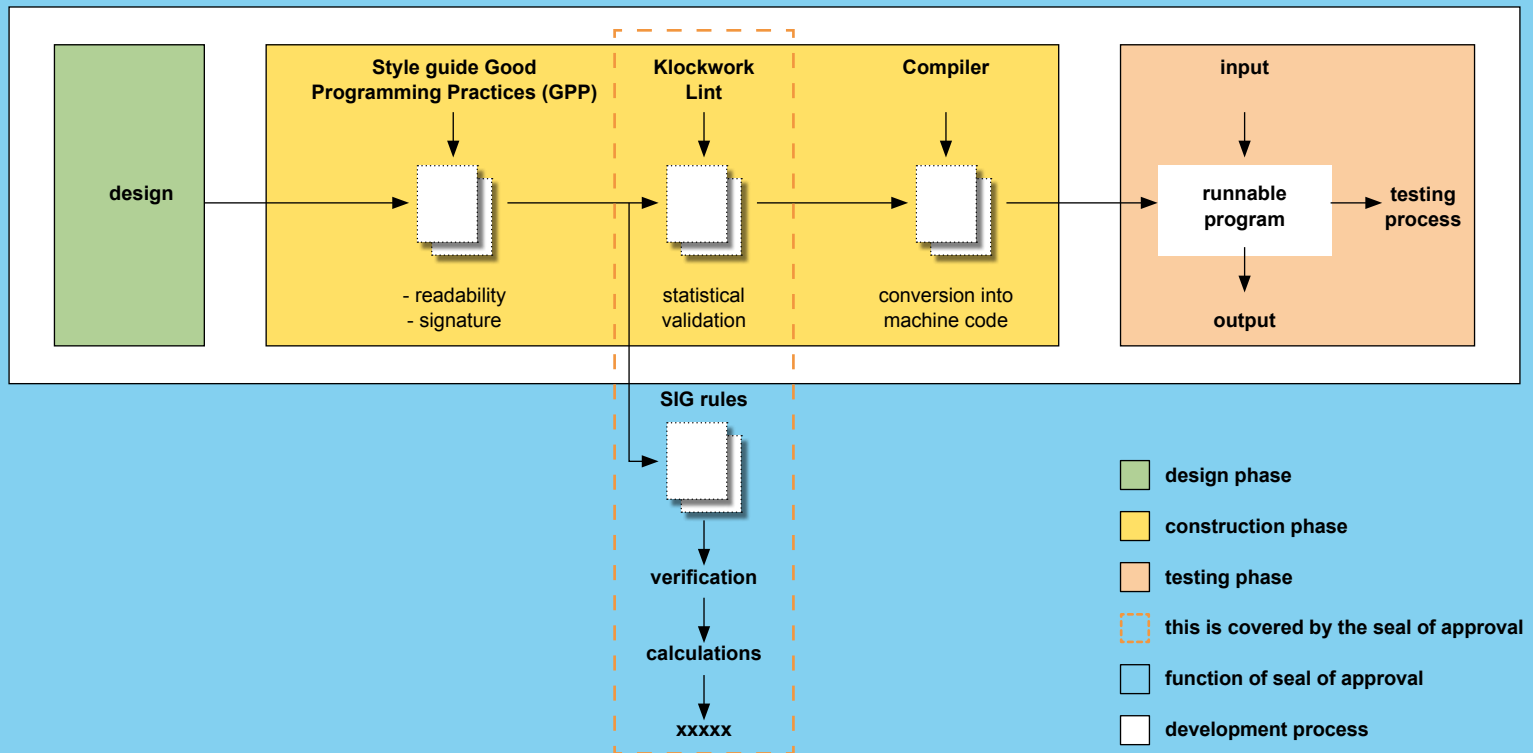
## Style and complexity

Other aspects that these code analysers monitor include the style and the size of the modules. To a computer, it doesn't matter what the code looks like as long as everything works properly. However, good developers ensure that their codes are well structured. In order to do this, rules and style guidelines (summarised in Good Programming Practices) have been developed. For example, all code that is functionally linked belongs in the same module. This defines functions that are accessible from the main program. If a function becomes too large, then you need to split it into separate sub functions. The more complex the code, the greater the chance of errors. Analysis can be performed to count the number of decisions ('if x, then y') for each function and issue a warning if there are too many. The compilation of the code is also a form of analysis. The compiler will only convert the code into machine code if it has been written in compliance with the rules of the programming language used. Once it reaches this stage software is now ready to use, and the functional tests can begin in order to determine whether or not the program works properly.

## Independent seal of approval

Once the client knows that everything works, the more difficult task of establishing the quality of the software begins. Will the code be easy to maintain and adjust at a later stage? It is for exactly this reason that the Software Improvement Group (SIG) was established. This certification institute gives an independent assessment regarding the quality of software products in the form of a seal of approval compliant with the ISO/IEC 9126 standard.





During the assessment, the SIG investigates the quality of the design and the process followed during development. The analysis investigates matters such as whether or not the functionality is divided into understandable modules and how the developer arrived at his/her design. In addition, interviews are held with system experts and the architects and designers of the code in order to gather information about their thought processes during development, the structure of the design, the objectives of the system, how these objectives have been achieved and how the designer tests his/her own design. This information is used during examination of the code in order to evaluate whether or not these thought processes and decisions are recognisable in the end result.

The value of the software seal of approval is that it translates a complex code into a simple guarantee of quality. A large system can consist of a thousand different modules which all make up one single software product. These modules are all subjected to dozens of tests, creating an impenetrable jumble of documentation. SIG translates this cacophony of information into a score of one to five stars, accompanied sometimes by advice for possible improvements.

#### Good code = flexibility

Maintenance is often the most expensive aspect of a system, although it is often overlooked when the development is outsourced. The ease with which adjustments can be made at a later date is determined by the maintainability of the system. It is far

more difficult to implement changes when the code is complex and has a low level of maintainability. After each adjustment, a great deal of testing is required to check that no other functions have been affected by the changes. The more maintainable the code, the quicker a developer can locate the correct module and implement a change by adding a compact section of code.

#### Expertise

Software seals of approval are a trend that offers a monitoring tool for the outsourcing of complex software systems. The client's key task is to provide a solution and to indicate the functional requirements with which the solution must comply. The technological side of the solution is not recorded in detail, but a number of criteria are fixed with regard to maintainability and expandability. A software seal of approval enables you to test these aspects. Our clients are currently testing out these seals of approval for themselves, with many of them possessing multiple Technolution systems assessed by the SIG during development. Despite being unfamiliar with the assessment method used by SIG, Technolution were still awarded high scores.

The seal of approval ultimately verifies whether or not the code is neatly structured. However, it does not verify that the system complies with the requirements. To do this, you still require the services of experts who monitor progress by means of a solid development strategy and numerous interim tests.



## /employee interview

# Enno Romkema

### \*knowledge is essential to our business

**Enno Romkema is the Chief Technology Officer (CTO) and co-founder of Technolution. His main driving force is his inexhaustible passion for technology.**

“I graduated from HTS Leeuwarden in 1979. After a brief period at Olivetti, I went to work for Brinkman, a business that specialised in operating systems for the horticultural sector. It was interesting work, but it was a one-product organisation, and I had greater ambitions. I wanted more variation in my work and I wanted to be active in numerous markets. Furthermore, I was not the only one at Brinkman with these ambitions: Jan, our current general manager, and Rob, who has since retired, also had similar aspirations. In 1987, we founded Technolution, a project-oriented organisation that allows us to work our way: conducting a wide variety of projects in a short space of time.

#### **Passion for technology**

Technology is crucial to our business, and it's no coincidence that we chose the name Technolution. The development of the business has always been closely linked with the development of technology. The situation in 1987 was completely different to the situation today. It was considerably simpler, and the PC had just made its entry. Computers were still isolated units that rarely communicated with each other, if ever. There were very few standards: the first major standard was the IBM PC, introduced in 1981. However, the microprocessor had already been developed, which was essential to what we wanted to do: build industrial systems. Nowadays, wireless technology is everywhere, and the evolution of components has created a third technological sector: programmable logic.

#### **Technology management**

In those days, I could oversee everything in my capacity as technical director. However, the

technological progress that has been made since then makes it impossible to know everything, so I now also rely on the support of my colleagues. We currently have five technology managers, each of which has their own specialist field. They keep a close eye on developments in their particular area of expertise. We want to be on the cutting edge of technology, just as our clients expect us to be. We want to be ready to answer questions that our clients haven't even asked yet, and we do this by means of internal projects that develop our knowledge of and practical experience with new technology. We did this with smart cards, with the 10GB link used in, amongst others, the FEI's Falcon electron microscope, and this was also how we developed the MobiBoxx, our in-car automation device. These projects are internal investments that we then use during our projects for clients. We do not seek to bring our own products onto the market, as this would put us into direct competition with our clients. Our goal is to conduct projects and deliver tailor-made solutions.

#### **Knowledge development**

Knowledge is essential to our business, and we conduct an active policy of knowledge sharing. After all, knowledge does not communicate itself: it has to be actively distributed and people need to be given the time and opportunity to absorb it. One way that we do this is via our Technology EXchange meetings. These meetings are organised by the technology manager, and they allow employees to explain particular areas of technology to their colleagues.

Knowledge is the only thing that multiplies when shared. It requires our employees to have a certain mindset characterised by openness and hunger to learn. Furthermore, these are the values that I, as technical director, must reflect to the rest of the company. It is an honour and a pleasure to co-manage this technology-driven organisation.”

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