



Cercia provides access to a wide range of solutions for the retail and service sectors. Our focus is on intelligent decision-making, taking into account customer behaviour as revealed by our advanced data analysis techniques. Any business can benefit from greater understanding of the information it collects on customers, transactions or stock.

- **Target your Marketing**

Analysing current customer profiles or previous responses to direct marketing allows us to identify those most likely to respond to a mailshot or other approach. You can then target those potential customers who are most likely to respond positively and profitably.

- **Understand your Customers**

Understanding your customer base is vital. Our techniques can segment, profile and visualise customers based on their behaviour, allowing you to target promotions, identify gaps in the market and understand the profitability of both individual customers and sectors.

- **Retain your Customers**

Loss of customers is an inevitable part of business, but how do you minimise that loss, and ensure that high value customers are retained? Churn prediction can identify those customers most likely to leave, allowing you to act before they do.

- **Perfect your Store Location**

Information on the profitability of existing stores can be used to predict new store profitability. Halfords used data mining techniques to predict the optimum locations for new stores.

- **Perfect your Store Layout**

In store stock layout has a direct effect on purchasing, Marks and Spencer use evolutionary computation techniques to optimise layout, resulting in greater profitability.

- **Detect Fraud**

Artificial intelligence techniques are industry standard for the detection of credit card and banking fraud. They can also be applied to substantially reduce stock "shrinkage" due to theft and errors.

- **Optimise Pricing**

Setting prices to maximise profitability in a competitive market can be complex, particularly when considering the response of competitors. Market modelling techniques are used by some of the most successful companies to increase their competitiveness.



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Cercia has developed a number of technologies for medical applications in conjunction with clinicians and healthcare professionals. These include sample and signal analysis techniques, systems to aid diagnosis and methods for analysis of microarray data. We also have a range of solutions that allow businesses to gain a greater understanding of the information they collect, whether it be about customers, manufacturing processes or medical trials.

- **EEG Analysis and Epilepsy Prediction**

New analysis techniques developed at Cercia allow prediction of epileptic seizures from EEG (electroencephalogram) readings, and enhanced analysis of EEG from other patients.

- **Advisory Systems for Diagnosis**

We have developed a very successful system, EPNet, for assisting diagnosis of diseases, including heart disease, diabetes, breast cancer, and thyroid problems.

A second system suggests diagnoses based on symptoms derived from ultrasound sonography.

- **Data Mining**

Data mining has been applied to areas as diverse as retrieving x-ray images similar to a current patient's from a database, predicting patient responses to treatment and detection of fraudulent medical insurance claims.

- **Microarray Analysis**

Microarrays make it possible to measure the activation levels of thousands of genes in a tissue sample to be measured. The sheer volume of information makes computer based analysis a necessity. These techniques find the structure of gene networks, identify genes implicated in diseases such as cancer, and make diagnostic predictions from gene data.

- **Spectrographic Analysis**

Spectrographic analysis can be applied to many types of biological samples, and automated systems can help identify the sample components and suggest diagnoses.



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# Manufacturing

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There are many different aspects to manufacturing, from optimisation to control, product design and production. With this come a variety of problems, often complex, and only partially understood. The Computational Intelligence (CI) solutions developed by Cercia excel at solving these issues, offering solutions where traditional methods perform poorly.

## Product Development

- **Optimise Complex Designs**

Many design optimisation problems are complex and have many objectives, without known optimal designs. CI methods excel under these circumstances, creating designs that perform better and save costs. Honda and British Aerospace use CI in their design practice in many areas, for example design of turbine blades. BMW uses similar methods to reduce crash impact in cars.

- **Make your Products Intelligent**

Since CI algorithms can adapt to their environment, products with embedded CI can perform optimally in dynamic environments. CI based elevator controls can adapt to the traffic for example.

- **Make your Products Fault-tolerant**

CI methods can be used to design hardware for fault-tolerance. They can also actively reconfigure a device in case of faults. Cercia has developed algorithms to design fault-tolerant circuits.

- **Find Novel Materials**

CI techniques can be used to intelligently search for novel materials with desired characteristics. Unilever has used this to find new, patentable peptides.

- **Improve Creativity**

CI techniques can be used in creative design to support the designer, automatically suggesting and evaluating designs. A train station designed entirely using CI methods has recently been completed in Japan.

## Production

- **Automatically Calibrate Products**

CI based techniques can be used to automate product calibration. This can increase your yield, and eliminate costly human calibration. CI driven post-production calibration is used to increase yields in analog electronic circuits by a Japanese mobile phone maker

- **Gain Flexibility in Production Scheduling**

Many conventional scheduling methods can only deliver static schedulers. CI based scheduler can react flexibly to events like incoming orders and machine breakdowns. Intel is using CI based scheduling in chip manufacturing.

- **Model Biological and Chemical Processes**

CI methods can be used to derive high-quality empirical models, to predict process variables such as acidity or NOx emissions. Dow Chemicals uses CI derived models as 'software' sensors for production variables that otherwise are inaccessible.

- **Spot Problems Early**

Cheap sensors and wireless networks mean that you can monitor every step in your production process. CI can help you make best use of this data, automatically detecting changes and unusual behavior. Cercia has developed methods to spot energy wastage and detect problems with machine tools before they fail.

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# Logistics and Transport

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Cercia provides a range of advanced technologies with specific applications within the transport and logistics industries. Our aim is to help businesses save money by optimising their transport efficiency through advanced routing and scheduling technologies.

- **Reduce your journey time**

Intelligent route optimisation can significantly lower transport overheads, dealing flexibly with complex constraints and demanding business metrics. Optimise your transport routes, cut down your costs and drive up your throughput using our advanced technologies.

- **Improve time efficiency**

Are you getting the most out of your resources? Powerful computational techniques can be applied to the generation of schedules and timetables, allowing you to improve resource utilisation and increase efficiency.

- **Save space**

Do your transport costs vary by volume rather than weight? Our solutions can help you optimise your packaging configurations to fit a varied selection of stock items into the smallest possible space, minimising associated shipping charges.

- **Minimise wastage**

Stock management is a difficult prediction task, with an optimal system requesting precisely the amount of any one stock that will be required. Our data mining techniques can help by improving prediction accuracy, minimising wastage and keeping all of your valuable customers reliably supplied.



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# Financial Sector

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Cercia has a wide range of experience in the Financial sector, working with partners from international banks to individual investors. For those in the financial services sector, our technologies allow you to streamline your business processes and keep on top of your data.

- **Detect fraud**

Ever felt like you're searching for a needle in a haystack? Our advanced data-mining and visualisation techniques can be used even by non-experts to identify and prioritise unusual or fraudulent patterns in data. For example, we have applied our work to identify fraudulent applications for credit cards.

- **Get the most from your data**

Are you really making the best use of your customer data to streamline your business processes and attract the clients that you really want? We can provide training and software tools to help you turn your data into a measurable business advantage.

- **Monitor your stock portfolio**

Detect and analyse risk profiles, and automatically identify exceptional buy and sell opportunities. Stay ahead of the trend without the cost.

- **Identify undervalued equities**

Automatically monitor fundamental data to highlight companies whose recent performance doesn't fit the mould.

- **Select promising investment opportunities**

Our novel technologies can screen a large volume of stocks to identify those with the greatest growth potential. We don't propose to remove the human touch, but we can certainly make your job a lot easier!



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# High Performance Computing

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The High Performance Computing and Business Incubation Centre is an initiative of the School of Computer Science at the University of Birmingham, in partnership with the AWM Innovation team. It provides affordable access to high-performance computing facilities to SMEs and start-up companies in the West Midlands.

Significant progress has been made in technology-driven and knowledge-intensive businesses in recent years due to the availability of affordable High-Performance Computing (HPC) facilities.

This is particularly true in areas such as modelling, simulation, visualisation, design, optimisation or data mining. These benefits can be applied to most industries including, ICT, automotive, medical, entertainment and many more.

HPC allows greater technological content and moves towards value-added products and services with increased efficiency. However, it is neither practical nor cost-effective for every SME to have their own facility since they present very high setup and maintenance costs.

Through our centre, local businesses have access to this hardware and expertise, as well as to the skills that are essential to the effective use of these resources.

The core of this centre is a 6-node, 24 Itanium-II CPU cluster. A dedicated file server offers more than 1TB of hard disk space with a high-speed link to the cluster. 21 high-specification workstations allow direct access to the cluster itself.

Cercia can offer these state-of-the-art facilities to SME's and start-up companies along with a range of other services.



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# What We Offer Your Business

[www.cercia.ac.uk](http://www.cercia.ac.uk)

Cercia was founded by AdvantageWest Midlands' to encourage the adoption of advanced computational technologies throughout the West Midlands' region.

## We work within three broad and overlapping areas:

- **Optimisation**

Helping processes run more quickly, more cheaply and more efficiently. Intelligent optimisation can streamline major business components, saving you time, money and resources.

- **Data mining**

Getting the most from your data by identifying salient features, highlighting anomalies and predicting future trends. Helping you to understand your business on a different level.

- **Design**

Producing optimised technical designs for high-tech engineering applications as well as novel creative artwork. Enhancing visual appeal, uniqueness and functional excellence.

## How we can help:

We offer free technical consultancy for a limited period (usually 1-2 days) to SMEs within the West Midlands region. As part of this valuable service, we can investigate cutting-edge research, write a background report or carry out a short implementation of some relevant technology.

We offer hands-on courses to participants from all industries, covering a wide range of topics from evolutionary optimisation and cluster computing to data mining and open-source software. Most of these are free for West-Midlands SMEs.

For more substantial research and development projects, we provide expert contract consultancy. If you have a computational project that might require several weeks



or months to carry out then this is the ideal option. We can work for any company, regardless of size or location and can also help you to apply for funding to reduce development costs.

We have significant expertise in applying to public and private funding sources in order to encourage long term research and development. During the financial year 2004-5, Cercia successfully obtained over £1 million of funding from government and industrial sources, supporting vital collaborations within the West Midlands region.

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# Monitoring Deterioration of Machine Tools

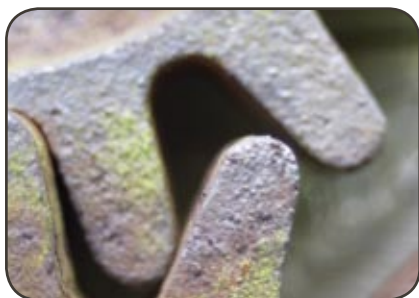
## Case Study

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Immediate detection of wear and breakage in a cutting process is very important for machine tool operators, as it can help prevent expensive damage to machine tools and work pieces. Very few reliable methods of detection existed until Cercia developed their real-time monitoring system.

As a direct inspection of the tool condition is only possible when the machine isn't in use, detection of problems slow down production. Real-time methods are therefore desirable, but need to be able to cope with a variety of conditions. Not only should they monitor whilst the machine is in operation, but must also take into account different materials and machine parameters.

The Cercia real-time condition monitoring system does just that; learns to recognise the states of a tool under different cutting conditions.



Based on motor sensors, which are inexpensive and easily installed, it can be applied to a wide variety of existing tools at low cost and without major refitting. It monitors the electric currents

used by motors in the machine. This information then builds mathematical models of the machine performance under a variety of conditions. These models are used alongside real data from the machine to detect any breakage or deterioration of the tool.

The system has identified wear and breakage of tools on a standard CNC machine (Makino-FNC74-A20). Sensors attached to the system, monitored the current of the spindle and feed motors. Cutting tests were conducted under different conditions in order to test real-world performance. The system was 95% accurate in detecting breakage.



Our technique is adaptable and can be easily applied to other machines, thus saving time and money for a variety of manufacturing processes.

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# Preventing Epileptic Seizures

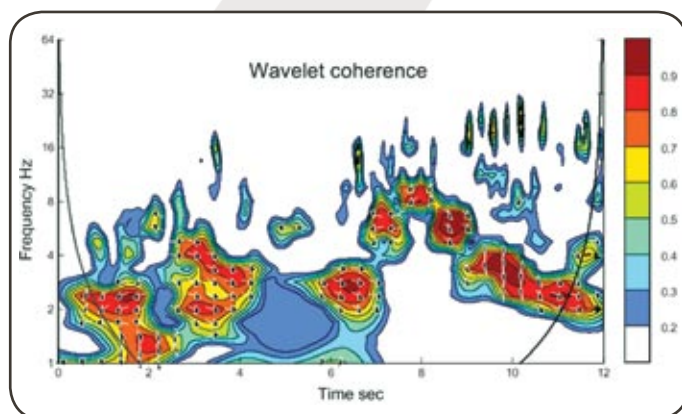
## Case Study

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Epilepsy is a common neurological disorder affecting around 400,000 people in the UK alone. The Electroencephalogram (EEG) has been an especially important clinical tool for its evaluation and treatment. Cercia has created an intelligent EEG monitoring system that predicts epileptic seizures could be used to activate an electrical interruption system, which would prevent oncoming seizures and improve drug management.

EEG monitoring systems are becoming an important clinical and research tool because they can capture, over time, the activity within different areas of the brain. However, current EEG systems do not contain the advanced data analysis tools necessary to explore the information hidden in the EEG data.

Cercia has developed an EEG analysis system using computational intelligence methods, which not only help to predict epileptic seizures in real time, but also help to study the mechanisms within the brain that lead to the seizures. The system works by detecting the preictal state (the period directly leading up to a seizure).



We are collaborating closely with academics and clinicians at the University of Birmingham and Queen Elizabeth Hospital, Birmingham. Further research is underway to improve the performance of our methods. Our aim is to build an intelligent EEG analysis system for clinical applications that would vastly improve the quality of life for epilepsy sufferers.

Our methods allow us to:

- Understand the underlying interactions between the two channels of EEG data
- Extract useful features for the prediction of epileptic seizures.
- Improve our understanding of communication between different areas of the brain.

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# Data Mining for Customer Retention

## Case Study

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Recruiting a new customer is many times more expensive than retaining an existing one, and so reducing the loss of customers has a direct effect on profitability. Many companies now realise that the data they collect about their customers holds the key to predicting both who may leave and who to target as potential new customers. Cercia have developed powerful data mining techniques that uncover these patterns.

The first to adopt this technology were in competitive subscription-driven industries, such as gas, electricity and telecommunications suppliers. Supermarkets and other large retail businesses use these methods to ensure they're meeting customer needs by analyzing purchase data supplied by customer loyalty cards. Building on experiences in these markets, it is now possible for any business with repeat customers to increase profitability through enhanced customer loyalty and reduced churn.

Given a customer database containing demographic, payment and purchase data, we build an accurate churn model that enables a supplier to target customers most likely to switch to a rival. One sector making good use of this is the telecommunications industry. Indeed in one telecoms applications, 80% of the potentially lost customers were retained after our technology identified them.

If you are selling to consumers, we can match your data with information from external databases, identifying lifestyle factors including shopping habits, likely income and age, to give you a deeper knowledge of who your customers really are.

Customer profiling and segmentation help you to understand your market, and target potential customers more effectively. Our technologies build profiles of your most profitable customers, and segment your customers into groups. Comparing these with demographic information will help you determine how to spend your marketing budget to recruit new customers most effectively.



Whether your customers are businesses or individual consumers, knowing more about them yields benefits.

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# Optimising Gritter-Truck Routes



## Case Study

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On winter nights with temperatures close to the freezing point, highway authorities face a difficult decision whether or not to salt the road network. The consequences of making a wrong decision are serious, as an untreated network is a major hazard. However, if salt is spread when it is not actually required, there are unnecessary financial and environmental consequences.

To solve this problem, Cercia and Entice Technology have developed a new salting route planner, which combines high-accuracy temperature prediction with intelligent optimisation.

XRWIS, developed by Entice, is a forecast system which predicts road surface condition over a 24 hour period. Local councils can use this information to ensure salt is only spread on roads that are likely to freeze.

However, without dynamic route optimisation, councils still have to use the same routes covering the whole network. To solve this issue, Cercia has developed an application that provides optimised routing for gritter trucks.

The application takes into account the temperature predictions as well as constraints like salt capacities, refilling locations, and salting priorities. It produces detailed route information for each truck, optimised for the predicted road conditions of that day. As the routes are calculated on a daily basis, unplanned events like road closures and changes in truck availability can also be taken into account.

The dynamic route optimisation leads to reduced fuel consumption and operation costs, along with faster gritting of important routes. It perfectly complements XRWIS, unlocking all the potential saving and environmental benefits.



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# Understanding Your Business



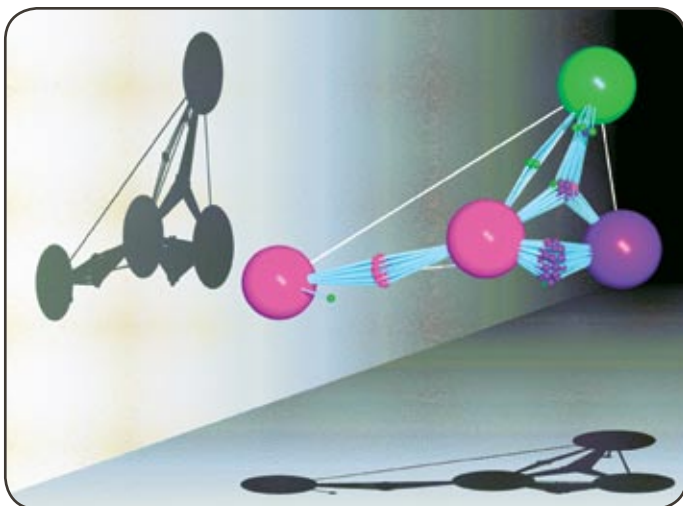
## Case Study

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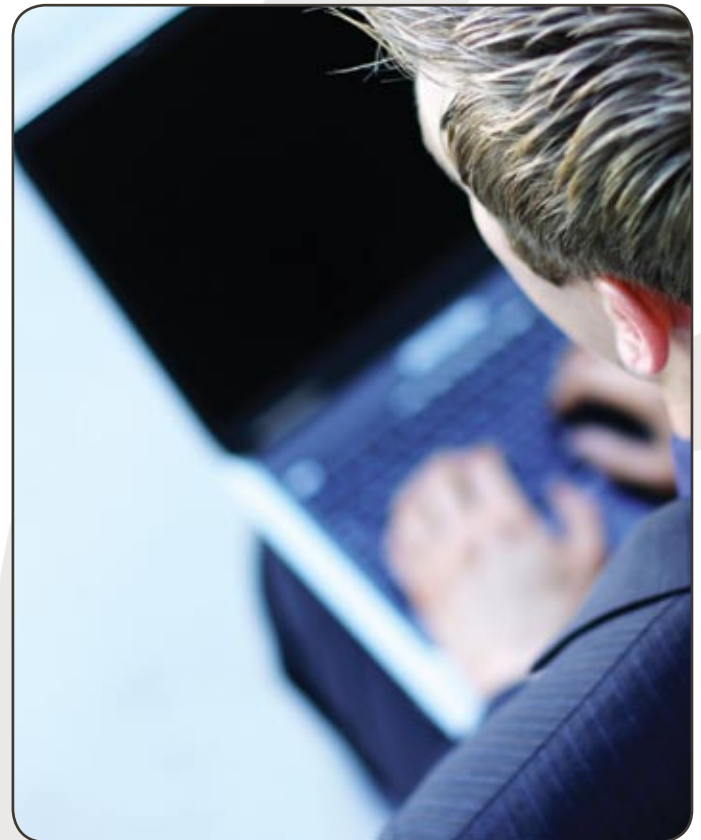
Force-based visualisation is inspired by the many physical forces that shape our world. Just as nature creates organised structures, physically-inspired visualisation techniques allow us to harness these methods to extract valuable information and trends from seemingly complex data.

Cercia has developed a suite of software applications based around the technique of force-based visualisation. The applications for this work are diverse and exciting and we have identified a number of real-world examples.

Force-based clustering works by placing sets of data points into 3D space and then joining them together with forces related to their similarity. Very similar points are joined with strong forces, whereas weaker forces join those that are less similar. All the pairs of points have an ideal mutual separation that they are aiming for; keeping similar points nearby and dissimilar particles further away. As the system relaxes, the points form into clusters.



This results in a self-organising system that automatically determines its most efficient configuration. An advanced 3D visualisation environment allows the clusters to be explored interactively. Our brains contain advanced visual processing systems, able to detect patterns and structures in pictures with far greater efficiency than within text or numerical tables.



Using this, the properties of potentially large and opaque data sets can be understood. For example, the analysis of internet web logs allows design teams to immediately see how traffic flows through their website and which pages are underperforming. Several companies are working with Cercia to integrate these valuable technologies into their products.

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# Intelligent Consumption Management

## Case Study

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Remote metering is increasingly being used to collect data from water, electricity, heat and gas consumption meters. Cercia have developed an intelligent monitoring system that allows site owners to automatically monitor meter readings, enabling them to spot unusual activity, thereby creating opportunities for cost savings.

Many businesses implement remote monitoring of their utility meters, which can mean the accumulation of data streams from as many as several hundred sources. Businesses are under pressure to reduce utility consumption levels due to increasing costs along with the introduction of EU directives requiring sites to implement strategies to reduce carbon dioxide emissions.

With regular meter readings, it becomes possible to closely monitor and manage consumption. This can be done manually, but for larger sites the effort required is prohibitive. The available technology for automatic monitoring could only detect large deviation from a fixed pattern, and was therefore only suitable to detect faults or breakdowns.

Cercia's technology learns the consumption patterns and dynamic behaviour of any site allowing the system to detect even small changes in these patterns. For example, it can recognise if equipment is left running overnight, or if an alteration in the setting of a heating system has changed the dynamic behaviour of a building. By automating this labour intensive work, our system frees the business to solve the detected problems, thereby saving time and money.

In practice, our system helps implement a highly detailed energy management scheme, spotting and eliminating many more sources of wastage than otherwise possible. This naturally leads to reduced utility consumption, lowering costs and helping to reduce the impact on the environment.



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Stock cutting is a potentially costly problem faced by many companies, especially those in the manufacturing sector. Cercia has developed a solution that maximises the space used and minimises any wastage.

Stock cutters faced with the problem of cutting steel pipes contacted Cercia for help. Due to a customer specification, the pipes needed to be cut a variety of different lengths. However there were various issues that needed to be addressed before doing this, including:

- How to cut the stock as efficiently as possible and minimise the waste produced.
- How to pack them as efficiently as possible.

Cercia has developed an application to fulfill these needs.

We have invented a novel evolutionary algorithm that can calculate optimal stock-cutting schemes. The algorithm performs significantly better than other existing methods in a number of real-world situations. It is sufficiently general to be applied to any related stock-cutting scenario.

Container packing can be regarded as a 3D version of stock cutting. The problem occurs daily for transportation and logistics companies. The key issue here is: How can we pack the maximum number of goods, which can be of different shapes and sizes, into the minimum number of fixed-size containers? We have developed software with a user-friendly interface to generate efficient container-packing schemes automatically. A user can enter the size of containers and sizes of the goods to be packed and the software displays the optimal packing configuration using interactive 3D graphics.



Some of the benefits of this are:

- Easy-to-follow optimised plans for quicker packing time
- Less resource wastage
- Reduced costs
- Increased efficiency

If you think your business could benefit from our expertise, then contact us now.