International Ergonomics Association

Chartered Institute of Ergonomics & Human Factors

# Giving your business the human factors edge

Steering Committee: Andrew Thatcher, Rosemary Seva , Nichola Adams, Kirsty Angerer, and Noorzaman Rashid
August 2022. IEA Press Publications. ISBN: 978-0-9796435-8-3

# Contents

# 1. Welcome

The International Ergonomics Association's Executive Committee and the Science Technology and Practice (IEA-STP) Standing Committee are pleased to bring you this brief publication to ensure you have baseline knowledge of ergonomics and human factors that is relevant to your role directing a company or organisation. This document was developed with input from human factors experts from around the world associated with the IEA-STP. For more information on the IEA, please visit iea.cc

Prof. Jose Orlando Gomes (IEA President) and Prof. Nancy Black (IEA-STP Chair)

# 2. Executive summary

Improving the efficiency and performance of any company is central to the role of every business leader. This publication introduces business leaders to the field of ergonomics and human factors, which applies the full range of human science to optimise the performance and wellbeing of employees in companies.

This publication presents the business case for :

- Human factors as a profit centre
- Measuring the impact of human factors
- Early intervention of human factors
- Using human factors to prepare for automation.

Today's business world is complex and challenging, with concerns about rapidly changing technologies that are transforming the nature of work, in addition to pandemics, climate change and resource uncertainty. Embracing a human factors approach to a company's operations provides a well-tested business tool for coping with these challenges.

A cross industry study by McKinsey & Company found that companies with a strong human-centred approach to their products and services out-performed their industry competitors by as much as two to one. These companies know how to repeatedly create successful products and services by adopting an inter-disciplinary approach that centres on understanding user needs and designing the products and services that emphasise these needs.

This human-centred approach applies not just to the products and services, but also to the design of work within companies. Companies that innovate their internal operations to design production lines, computer systems and internal processes to be compatible with human capabilities see ROIs that range from 10% to 500%.

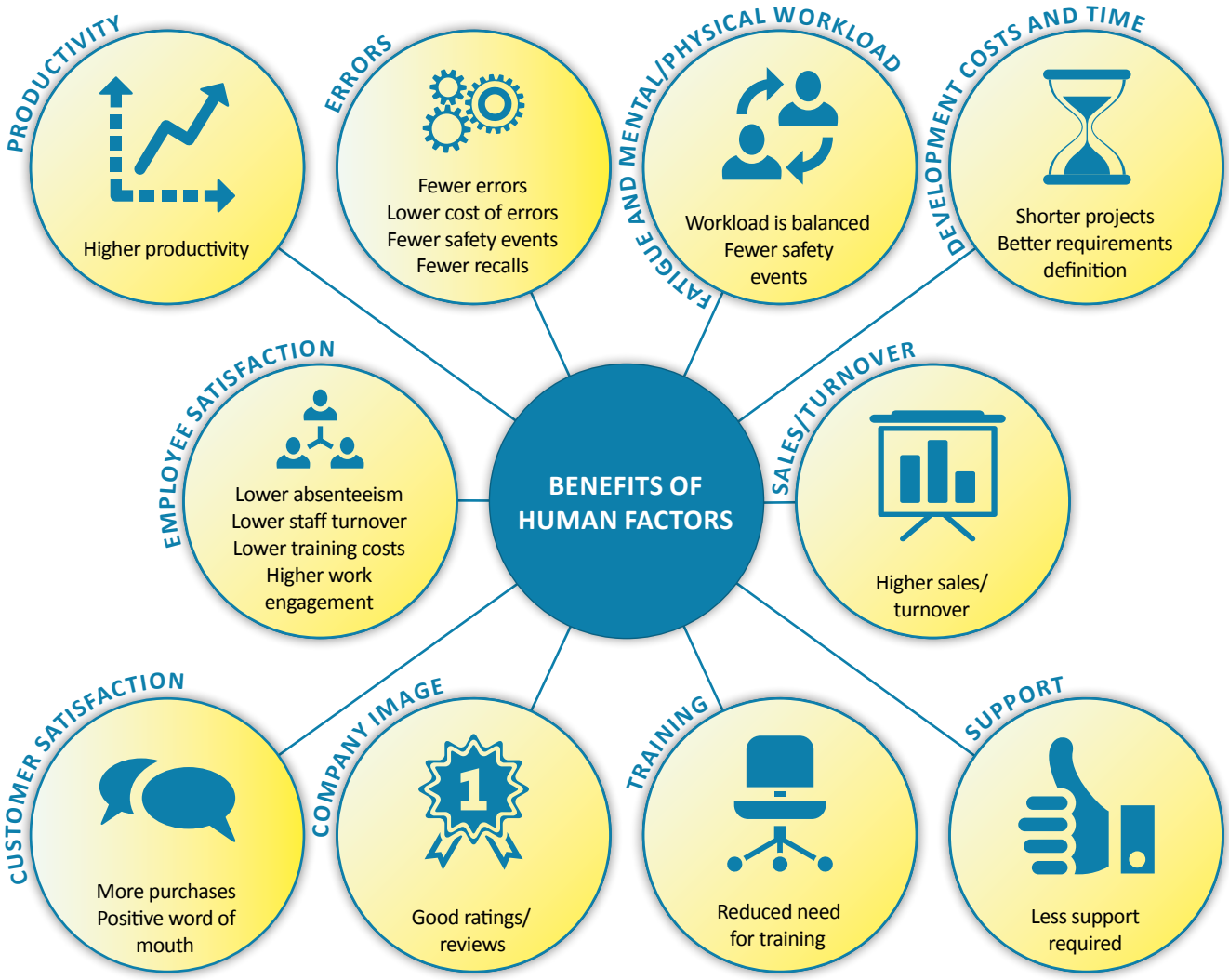
Not only do these interventions reduce costs from accidents and injuries, and reduce training and maintenance costs, companies typically see significant improvements in worker productivity and job satisfaction, which reduce employee turnover and absenteeism.

In a business climate where companies are increasingly finding it hard to hire and keep good personnel, and where managing costs is paramount, there is no room to neglect the productivity and safety of workers.

The field of ergonomics and human factors has more than 70 years of scientific knowledge of how people work, and of designing technologies, workplaces and processes to optimise human performance while at the same time reducing injuries and costs.

This win-win approach is key to optimising the functioning of any organisation and to creating successful products and services.

## Benefits of Human Factors




## Effectiveness of Human Factors programmes (from 250 case studies in Goggins et al., 2008)

| | | | |
|---|---|---|---|
| Cost-benefit ratio | 1:2.5 | Average: 1:18.7 | 1:72 |
| Payback period | 4.4 years | Average: 0.7 years | 0.03 years |
| Productivity | 0.2% increase | Average: 25% increase | 80% increase |
| Workers' compensation costs | 15% decrease | Average: 68% decrease | 100% decrease |
| Costs per claim | 20% decrease | Average: 39% decrease | 80% decrease |
| Errors | 8% decrease | Average: 67% decrease | 100% decrease |
| Employee turnover | 3% decrease | Average: 48% decrease | 100% decrease |
| Absenteeism | 14% decrease | Average: 58% decrease | 98% decrease |

# 3. What is ergonomics and human factors?

All organisational, business and work situations involve people. They are either workers, managers, those maintaining work systems, users or customers.

The multidisciplinary field that brings together people, technology and processes to optimise how they function as a whole is referred to as ergonomics and human factors. The two terms are synonymous although 'human factors' is finding more favour in many industries and will be used through the rest of this document.

This includes usability experience (UX), user-centred design (UCD), user interface design (UID), human-computer interaction (HCI), human systems integration (HSI), interaction design (IxD), human-centric work and cognitive engineering.

There are three characteristics that distinguish human factors from other fields that focus on people (such as psychology, sociology or medicine):

1. Human factors is design-focused; specifically the design of work practices, tools, products, machines and equipment that people use. This includes the design of the workplace and design of the organisation of work. The goal is to proactively intervene to prevent things from going wrong in the first place, although it is sometimes necessary to fix things that have already gone wrong.
2. Human factors focuses on the whole system to optimise performance outcomes. Simply inserting a new technology into existing processes won't achieve the desired results unless the people who need to work with that technology are considered in the broader context.
3. Human factors is concerned with the dual outcomes of whole system performance and human wellbeing. It does not see these outcomes as separate but rather as two sides of the same coin. It is concerned with improving the efficiency, effectiveness and productivity of work, and the comfort, safety and health of the worker to optimise performance.

Some believe anyone can design systems that work well for people. If human factors design is simply common sense, this begs the question why there are so many so-called human errors, accidents, recalls and product failures. History is littered with costly and dangerous accidents that resulted from failing to employ or listen to human factors professionals, including the Chernobyl nuclear disaster, the Boeing 737-Max 8 crashes, the Bhopal Union Carbide gas leak disaster and the Deepwater Horizon oil spill. Without the proper training, even well-meaning people are generally not aware of where the hazards lie and how to develop solutions to avoid them.

Human factors is built on decades of scientific knowledge of human characteristics and capabilities, combined with engineering knowledge on how to design systems that fit people, augmenting their best features while compensating for their limitations.

It uses training in psychology (to effect behaviour change and complex system design), biomechanics (to optimise physical working patterns) and human physical characteristics (to ensure the product fits the user correctly) to make highly effective changes in the design of technologies and work processes, preventing errors and accidents and increasing worker output.

Built around a strong science base focused on how people perform with technology, human factors uses successfully tested techniques that can be adopted across almost any industry.

**The price of doing nothing**

Failing to keep up with companies who adopt human factors design principles can be costly. And poor user experience can deeply hurt a company's brand. In 2011, Ford dropped from fifth place to 23rd place in the US automotive quality survey because of consumer complaints about the un-intuitiveness and complexity of the MyFord Touch system, which was used to control the entertainment, climate and navigation systems.
A year later, Ford dropped a further four places to 27th. Doing nothing was far more costly than taking the human-centred approach seriously.

# 4. Human factors as a profit centre

Outdated thinking conceptualises human factors programmes as a cost without fully realising the benefits. While it might seem like it is focused exclusively on people, human factors actually focuses on improving human contributions to better products and services which add directly to an organisation's bottom line. This is achieved by increasing the productivity and efficiency of the workforce, by producing products and services that are superior to competitors, by reducing errors and increasing safety, by reducing or eliminating waste and ensuring that the workforce is healthy and able to work to its full potential. An investment in human factors is, therefore, a direct investment as a profit centre. While the exact value-add to an organisation's profits will differ from industry to industry, the impact on profits is clear and demonstrable.

There are multiple examples in both large and small organisations where investment in human factors has produced significant, measurable returns. The most direct path to profits using this approach is through producing better work processes, work systems or products. This creates shareholder value simply by improving the way work is done. This is what might be referred to as production human factors.

Another direct path is through product human factors. Products and services that take user needs and interactions into account are more likely to be used and enjoyed by customers. This leads directly to more purchases and better brand loyalty. This is also an important way in which an organisation can distinguish itself from its competitors through increasing its reputation among customers who use the products and services.

A third direct path is through cost savings achieved by the introduction of human factors practices. Ultimately, this is achieved by designing more efficient work processes. One of the main principles of human factors is to design work to maximise efficiencies, including:

- Reducing costs by eliminating non-value-adding activities or tasks
- Reducing material waste
- Minimising effort and materials.

Efficiency can be achieved by optimising the relationship between the worker and workplace. Depending on the work context, this could mean optimising human effort (reducing wasteful effort) or optimising material use (reducing waste materials).

Human factors also reduces the chances for incidents, errors or accidents. A better understanding of human work in context allows human factors to identify sources of misunderstanding between the worker and their work (including the technology) and to eliminate/close the gap in any misunderstandings. The end-product is a work system that minimises error and therefore the chance for accidents. Ultimately, the goal is an organisation that is more efficient and more likely to minimise reputational damage from accidents or product recalls.

Increased efficiency also means a reduced impact on the environment. More efficient use of materials means that fewer resources are needed for the same (or more) outputs. In addition, less waste means less direct damage to the environment. This has the added benefit of designing work that can help an organisation meet its sustainability goals.

It is not only a duty, but also a moral responsibility and good business sense to help employees optimise working behaviours, systems and products that suit our own way of working, rather than us humans having to adapt to suit a certain set-up or design.

Finally, human factors can also save costs by helping an organisation meet best-practice regulatory or mandatory requirements. These are minimum requirements, not necessarily optimal or the best requirements. The cost savings are achieved because the new human factors approach exceeds the minimum requirements and saves the organisation from fines, litigation and additional costs of later work system improvements.

## Financial bottom-line profits from Human factors

**Assembly job redesign:** 10.76% ROI in the first year and 30.10% ROI in the subsequent year
(Lyon, 1997)

**Workstation redesign:** 15% increase in productivity
(Hendrick, 2003)

**Robotic case palletizer:** 17% ROI over a 10-year period
(Rodrigues, 2001)

**Log truck redesign:** 1:9.4 first year cost-benefit ratio
(Hendrick, 2008)

**Electric utility tool replacement:** $300,000 capital investment paid back in four months
(Seeley & Marklin, 2003)

**Motherboard redesign:** $581,495/year factory savings and $142,105/year customer savings
(Sen & Yeow, 2003)

**Computer usability:** 200% – 500% return on a 6% budget investment
(Nielson, 1993)

### Case study
**Tractor-trailer redesign (Hendrick, 1996)**

**PROBLEM:** A logging company was concerned that its tractor-trailer drivers were complaining of excessive pains in their lower and upper back and in their legs.

**SOLUTION:** A human factors investigation was used to improve the seating and visibility of the tractor-trailer forwarding units.

**OUTCOME:** The changes resulted in a better operating position for loading, improved vision and improved operator comfort. Down times caused by accident damage went down significantly per year per unit, while daily timber extraction increased by one load per day per vehicle. Together, a cost-benefit ratio of 1 to 9.4 over a single year was achieved.

### Making a difference
**Waste not, want not**

Reducing waste in manufacturing is much sought after. To support this, a framework process was established called the Suzhal Management System, which integrates human factors and lean manufacturing tools to consider the human-machine interactions. This helps to understand the skill deficit and deskilling of processes, and brings about reliable low-cost automation and reduces the disruption of innovating. The Suzhal framework has been applied to a range of industries and continually evaluated. These evaluations have shown process productivity improvements of 30–800%; decreases in worker attrition; individual productivity of 30–100%; a 60% reduction in manufacturing floor-space; audited cost savings and reduced costs from poor quality and rework.

### Protecting Workers

In the UK, the HSE DSE 1992 Act requires all employers to look after their employees with a human factors programme, delivered to wherever they are permanently working. In South Africa, the DoEL requires that all companies conduct a human factors risk assessment annually and to design and implement plans to reduce risks.

## Case study

**Work redesign in a furniture manufacturing plant (Attwood Leighs, 2015)**

**PROBLEM:** The work performed in a furniture factory was assessed to be physically demanding and entailed heavy lifting, pushing and pulling of large heavy items, repetitive work with tools such as staple guns, and fine upholstery work using a sewing machine. All this work required a large degree of manual handling. The manufacturer identified a significant number of work-related injuries among staff that were causing absence from work, inability to undertake normal duties and high staff turnover. In the two years prior to seeking help from human factors professionals, there were a total of 19 musculoskeletal injuries that were reportable.

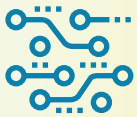
**SOLUTION:** Human factors specialists identified a number of changes to the way work was carried out, such as job rotation and manual handling training, as well as the design of the workplace, such as the introduction of conveyors and empowering managers to make changes to reduce human factors risks.

**OUTCOME:** Reportable musculoskeletal injuries decreased to three during the year of training and programme implementation. The following year they had one reportable musculoskeletal injury. Year three and four post intervention saw no reportable injuries. The human factors champion in the organisation presented the participatory ergonomics programme to their insurers resulting in a £60,000 per annum reduction in insurance premiums. ROI over four years was £9.51 for every £1 spent. The project payback period was five months.

**Impact of human factors interventions in manufacturing industries around the world (Larson, 2014)**

## Payback period

Electronics manufacturing



**0.5 weeks**

Process manufacturing

**1 to 18 weeks**

Textile manufacturing

**9.6 weeks**

Office work

**2 weeks**

Various manufacturing settings worldwide

**0.7 to 59 weeks**

16.4 (average)

## Percentage rise in productivity

Valve and furniture manufacturing

**15% to 20%**

Call centre

**45%**

Air handling unit manufacturer

**140%**

Order picking warehouse

**8.4%**

Furniture manufacturing

**46%**

Various manufacturing settings

**1.6% (average)**

## Operational efficiency

**8% decrease in repeating work**

Hospital and medical manufacturing

**3% to 5% decrease in waste**

# 5. Measuring the impact of human factors

Whether the bottom line is profit, productivity, production numbers, diversifying the workforce, safety or environmental concerns, the introduction of human factors practices are measurable.

A human factors programme's impact will be directly measurable in terms of improved productivity rates, reduced sick leave, reduced medical claims and reduced staff turnover. Being proactive in looking after employees' wellbeing has been shown to be a powerful influencer in encouraging employees to stay motivated and loyal, in engaging and retaining employees, as well as attracting the right talent in the first place.

Human factors is a hugely effective way of looking after the wellbeing of your employees, both physically and mentally. Indeed, case studies have shown that it can sometimes deliver between 300% and 1000% ROI, with payback periods in as little as a few days. Additionally, annual gains in system productivity are on average 45%, with a 3% to 5% decrease in wastage, and an 8% decrease in rework (re-doing work because it is of poor quality).

The majority of human factors work is to problem solve and detect the core reasons why a particular way of working is inefficient or causes pain, why one part of an organisation has a longer processing time, or why a critical error in a system keeps occurring. Together with full user or employee participation, human factors uses a variety of investigative tools and procedures to identify the reasons and make the optimal changes required to prevent risks of measurable deliverables, such as reduced back pain, reduced mental overload and reduced system failure, that have such a critical effect on the organisation's bottom line.

### Making a difference
**Back to their best**

Back pain is one of the biggest causes of sick leave along with stress. It affects productivity levels, absenteeism rates, medical claims and employee turnover. Back pain is usually the result of poor design of the workplace, incorrect equipment or poor training in work practices. For an individual to work to their full potential and be an optimal part of the team, their mind and body need to be free from pain and mental overload. Human factors is used to identify and remove the source of pain.

### Case study
**Redesign in an emergency sign manufacturing plant (de Looze et al., 2010)**

**PROBLEM:** A sign manufacturing company that produces emergency lights needed to move to a larger space. This provided the opportunity to reconceptualise the design of the manufacturing plant.

**SOLUTION:** A human factors process-innovation project took place in two departments: print assembly and final assembly. The print assembly department produces printed circuit boards. The final assembly department assembles and packs all the components. Human factors interventions included the design of the workstations, job rotation between work stations, redesign of the assembly tools to be lightweight, improved lighting and height adjustable workstations. Performance effects that were measured included productivity, order lead time and quality. Estimates of these effects were made on the basis of the figures obtained six months after implementation.

**OUTCOME:** Productivity increased significantly both in print assembly (by 20%) and final assembly (by 40%). Based on these figures, it was estimated that, for the same production output, the amount of personnel could be reduced by seven workers in print assembly and by four workers in final assembly. With regard to quality, there were fewer failures observed in the new situation. In fact, significantly less rework was observed in the new situation. It was estimated that 25% of the reduction in rework could be directly attributed to the project. The order lead time was estimated to decrease by 40% resulting in various benefits: less work in process, shorter delivery times resulting in higher customer satisfaction, and higher flexibility to adapt to demand.

### Case study
**More efficient parcel handling (Parsons, 2015)**

**PROBLEM:** Royal Mail collects, processes and delivers more than 1.1 billion parcels each year throughout the UK and a high proportion of these are small packages. Manual sorting was a labour-intensive task, with items being sorted into mail bags which had to be sealed, labelled, loaded into wheeled containers for despatch then opened and tipped to empty the contents at their destination. Manual handling activities relating to mail bags are amongst the most physically demanding and labour intensive tasks in Royal Mail.

**SOLUTION:** A human factors work analysis of the parcel handlers was conducted to identify improvements in the workplace and work design. The redesign resulted in a more efficient parcel sorting process; reduced manual handing risks by removing the need to lift, sort and empty mail bags; and improved working postures when sorting parcels because the parcels are presented at a good working height.

**OUTCOME:** A reduction in bag handling tasks resulted in reduced sorting time for parcels by around 25 minutes for every 1,000 parcels. A change to a more durable parcel sleeve reduced the failure rate and costs of repair and replacement.

# 6. Early intervention of human factors

There is wisdom in testing design ideas early. The Amazon case study (right) showed that a problematic button was only discovered through usability testing, where real users were asked to perform tasks and were interviewed. Not many organisations include this aspect in their project plan because of the tight schedules and the perceived extra cost of user testing. This oversight, however, can be very costly for high volumes of transactions such as Amazon and other popular e-commerce websites. Twenty-six brands in Lazada, for example, generated US$1 million sales within 24 hours during one sale. With this volume of transactions, a design error delivered to market can have a catastrophic effect on a business.

How many times did you wish an online process step was not there? How many times did you abandon a website because you thought you were wasting too much time? Now think about your business and its interface with the customer. You might need the science to discover undetected losses. By the time the product or service has gone to market, the reputational damage may already have happened. Many businesses have found that it is very expensive to recover from reputational damage. Early intervention using the human factors approach drastically reduces costs and increases the chance of profits.

Similar benefits can be achieved inside an organisation. Research has shown that an intervention to reduce discomfort and pain from seating can take as little as two weeks for a body to reverse the damage due to repetitive stressors if addressed early on. For instance, repetitive strain injuries, such as carpal tunnel syndrome, are exacerbated by awkward wrist postures being maintained while working. Education surrounding the risk factors and a simple change of position, prevents months of pain and even surgery. Even on a basic salary, the cost of that person's disability on the company's bottom line can be huge in terms of weeks or even months of lost work during the rehabilitation, re-training, or re-hiring processes.

During a human factors product development cycle, getting human feedback throughout the design process is critical. In this way, fewer prototypes are required and the timeline for route to market is decreased. User error can be designed out early on, rather than requiring expensive changes later in the process. Quality is assured and usability is enhanced, balancing the mental and physical demands on the end user. For this reason, it can be shown that the human-centred approach can dramatically reduce design costs.

Human factors has the greatest and most sustainable effect on the organisation when that intervention happens early in the design or production process. Intervening early means getting it right the first time and removing the costs of late changes or product recalls.

### Making a difference
**Counting the cost**

The business consequences of human factors had usually gone unnoticed until Amazon had a glimpse of its immensity – US$300 million a year! In Amazon's case they didn't realise that a simple registration form would dissuade customers from making a purchase. The designers thought that getting the customer's email address would make the transaction quicker the next time they bought. They thought that customers were used to filling out registration forms online. These assumptions sounded valid, until they removed the registration button. Removing this one button increased the sales by 45% in a year, amounting to US$300 million. Should top-level business leaders really concern themselves with issues like a registration button? Maybe not, but they should ensure that someone in the organisation does, because US$300 million is a significant outcome by any standard. In the case of Amazon, the hero was a user experience professional who took the time to understand the customer journey, including their motivation and stumbling points.

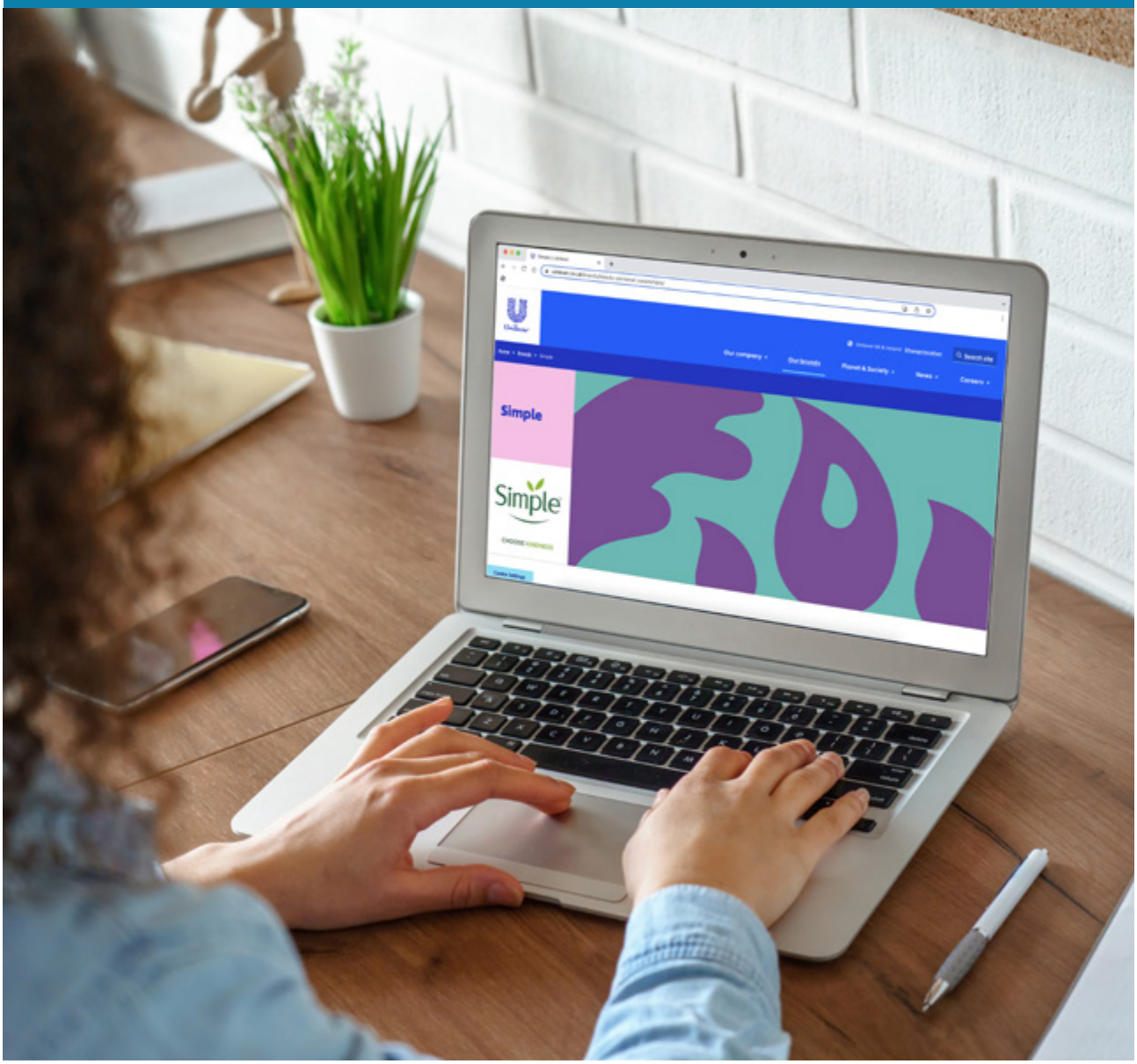
## Case study

**Images on e-commerce websites (Goodman-Deane, Waller, Bradley & Clarkson, 2018)**

**PROBLEM:** Images of products on e-commerce retail websites typically consist of product photographs. These images often fail to communicate critical product information, such as brand, product type, product variant and size. When the information is present, it is often small or unclear so that very few people can see or understand it, which may result in a wrong purchase or no purchase at all. This issue is increasingly important as more people shop from mobile devices.

**SOLUTION:** Human factors was used to help develop solutions that would improve visual clarity and that would allow for customisation by the consumer. Interventions included a simplification of images to the essential human-centred components, improving visual acuity levels and developing a design toolkit to use across all the brands.

**OUTCOME:** The interventions produced an improved shopping experience. Consumers were able to find the products they wanted more quickly and easily and without having to resort to reading through longer product descriptions. Investigations found a sales uplift of 20% on Unilever's Simple range, and a 24% uplift on the Magnum range. On the Coles website, Surf-branded products saw an average weekly sales uplift of 74%.



# 7. Using human factors to prepare for automation

"To err is human" is a common phrase often used to justify removing the human from the operation of a system and (usually) replacing them with technology, robotics or an automated system. It is true that humans do make mistakes; in fact, making mistakes is a fundamental pathway to learning and improving. Unfortunately, removing the human from direct operational control doesn't solve the problem of human error. All it does is displace the human, often making it more difficult for them to intervene in an effective way, especially in highly volatile circumstances or high-reliability contexts.

Imagine a hypothetical fully automated, intelligent system that can perform a set of functions without human intervention once initiated by a human being. All these systems are essentially designed and built for the benefit of humans. Either they produce products that we consume, a service that we use, or a system where it is safer for the human to work (for example in nuclear power plant maintenance). Self-drive cars drive people from A to B, self-drive trucks deliver products and services to people. Even in fully automated manufacturing plants, people are needed to design the automation, implement the automation, monitor the automation, maintain the automation, and replace the automation when it malfunctions or becomes obsolete. Automated systems might appear profitable until you add in these additional costs. Automation might help make things safer, cheaper, healthier or more productive in the short term, but ultimately the human has to deal with the end-product or consequences of automation.

Systems which have some automation (and even those systems that are fully automated) require humans to carefully monitor the systems to make sure they are functioning optimally. Human operators are required to jump in when things go wrong or when the operating conditions fall outside the automation parameters. This is required because the external environment is inherently chaotic. For example, pilots must take over flight control of an aircraft when it is flying in conditions that haven't been programmed into the automation or when the automation fails (like in the case of the Boeing 737 Max). Doctors must make decisions on whether to accept automated advice. Power plant operators must decide what to do when the demand exceeds the supply.

Removing human operators from the physical operation of a system doesn't remove them entirely from the process. Indeed automation makes the tasks of the human operator increasingly complex. The human operator still has to determine the current state of the system, construct an image of how the system operates, and calculate all the possible future states of the system to predict if something might be going wrong. In fact, the more we automate and remove the human from direct operation, the more they must make decisions about when to intervene, based on less information that is increasingly abstract. It is known that humans are actually not very good at the monitoring role because they get bored and distracted quite easily. By automating, the human operator's task becomes more difficult and less reliable, just as it becomes more important. Human factors becomes increasingly important in the design of the automation's interface, to enable the human operator to effectively perform their task.

For these reasons, human factors is involved in planning how automation might help us in the future. Its role is proactive; examining current systems to identify shortcomings, imagining future designs and identifying where the human might be needed in the system in order to provide them with the best options to perform their job optimally. Currently, human factors might focus on how to design better automated systems, unmanned vehicles and aircraft, but in future this will also involve envisaging the roles of humans in AI, bio-engineering, augmented reality, long-distance space travel and neurological implants. The discipline will play a key role in determining:

- what roles humans will play in these systems
- what humans will need to do the jobs better, more efficiently, or easily
- what support systems are needed for proper integration with the rest of society in the future.

## Case study

**Energy savings in the military (Forrest, 2018)**

**PROBLEM:** The UK Ministry of Defence (MOD) is a significant consumer of energy, both in delivering effective military capability as well as powering the infrastructure requirements at home and abroad. In 2012, the MOD set itself a target to reduce fossil fuel expenditure by 18% by 2020/21, against a 2009/10 baseline.

**SOLUTION:** An understanding of behaviours, the context of those behaviours and the attitudes is essential for energy saving. An approach, called the Future Interventions Start Here (FISH), was developed to identify energy-saving behaviour change interventions at low cost. Behaviour change interventions included providing regular feedback on energy usage, fact sheets to dispel common energy saving myths and reinforce energy-saving tips, and visual prompts – such as stickers, checklists, posters and reminders.

**OUTCOME:** Energy savings were made of up to 26% per month which exceeded MOD targets of 18% and led to meaningful financial savings.

## Case study

**AT&T Global Information Solutions workstation design (Hendrick, 1996)**

**PROBLEM:** In the early days, AT&T Global Information Solutions employed 800 people in the manufacturing of large mainframe computers. Significant injuries were identified in a number of the manual handling tasks.

**SOLUTION:** Based on extensive work site analyses to identify human factors deficiencies, the company made workstation improvements and provided proper lifting training for all employees. In a second round of changes, conveyor systems were replaced with small, individual scissors-lift platforms, and heavy pneumatic drivers with lighter electric ones; this was followed by moving from an assembly line process to one where each worker built the entire cabinet, with the ability to readily shift from a standing to sitting position.

**OUTCOME:** In the first year following the changes, worker compensation losses dropped more than 75%. In the second year, a further reduction in worker compensation losses was realised to 97% of the original costs. Lost work days due to injury were reduced from a high of 298 days in the year prior to the interventions to zero in the following two years. The human factors interventions resulted in significant reductions in compensation costs over a four-year period, even without taking the improvements in productivity into account.

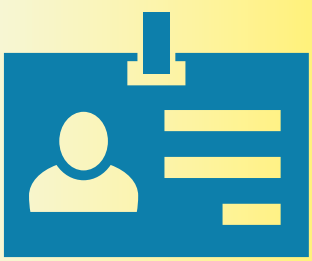
# 8. How to introduce human factors to a business

**Here are the key initial steps to introducing human factors to a business:**

Get a human factors evaluation carried out to identify prospective intervention areas. Look for human factors professionals who are members of professional bodies in respective countries (like the Chartered Institute of Ergonomics and Human Factors (CIEHF) if you are in the UK or the Board of Certification in Professional Ergonomics (BCPE) if you are in the USA).

See iea.cc/member-societies-networks/federated-societies/ for a list of societies federated to the IEA.

Hire human factors specialists into the organisation and incorporate them into development programmes. Just like for other areas of scientific endeavour, there is a significant body of knowledge that needs to be acquired through the appropriate education. As a multidisciplinary field, professionals may have a wide variety of degree titles, including industrial engineering, psychology, kinesiology or physiology.



Advocate for the value of the human factors approach by using the talking points from this publication.

Look at appointing human factors professionals at senior levels in the organisation to advise the organisational leadership early.

- Get them to develop a human factors programme (or the capability) for the organisation by reading future publications.
- Get them to learn more about the current and future human factors regulatory framework for respective regions and industries.
- Ensure that human factors is part of the organisation's design process.
- Ensure that the capital procurement process in the organisation considers the human factors aspects of new equipment and facilities to reduce risk proactively.

Learn how to create a resilient organisation or product portfolio.

# 9. Additional case studies

The International Ergonomics Association: HFE in practice
https://iea.cc/ergonomics-in-practice

The Chartered Institute for Ergonomics and Human Factors: Human Connection I and Human Connection II
https://ergonomics.org.uk/resource/human-connection-1.html

https://ergonomics.org.uk/resource/human-connection-2.html

The Human Factors and Ergonomics Society: The Ergonomics of Economics is the Economics of Ergonomics and the Human Factors and Ergonomics Society Policy Statement on Occupational Ergonomics for Industry 4.0
https://www.hfes.org/Portals/0/Documents/Hendrick.pdf

https://www.hfes.org/Portals/0/Documents/Government%20Relations/HFES%20Policy%20-%20Occupational%20Ergnomics%2011.11.2020%20-%20FINAL.pdf?ver=2020-11-11-130626-293

Humanscale: Return on Investment for Ergonomics Interventions
https://www.humanscale.com/userfiles/file/return-on-investement_03272015.pdf

# 10. Contributors

Nichola Adams

Tom Albin

Peter Buckle

David Caple

Jan Dul

Robin Ellis

Mica Endsley

Anindya Ganguli

Courtney Grant

Amrita Maguire

Ruurd Pikaar

Chris Ramsden

Rosemary Seva

Andrew Thatcher

Designed by Connect Communications and published by IEA Press Publications with the support of the Chartered Institute of Ergonomics and Human Factors