

ERGONOMIC ISSUES ARISING FROM THE 'NEXT MANUFACTURING REVOLUTION'

M.A. Sinclair & C.E. Siemieniuch,

*ESoS Research Group
School of Electrical, Electronic & System Engineering
Loughborough University of Technology*

The paper outlines briefly the contents of the government-sponsored document, 'The Next Manufacturing Revolution', with its emphasis on practices appropriate to the demands for sustainability required by population growth and emissions control, and then explores some of the implications of the contents for the practice of ergonomics, particularly in relation to job design. It is clear that there are some significant extensions required to the knowledge classes, processes and practices of ergonomists; there are also some implications for the Institute's role as a source of advice.

Introduction

The government-endorsed report, 'The Next Manufacturing Revolution' (<http://www.nextmanufacturingrevolution.org>) is an attempt to make Britain's manufacturing sector more competitive in the world of 2030 and beyond; a world in which environmental sustainability will be a key issue, in addition to the usual competitive and technical challenges (Sulston 2012)

The document describes the benefits that will accrue from this revolution:

"This study presents opportunities to improve non-labour resource productivity which could enable a revolution in manufacturing and are estimated, conservatively, to be worth for the UK:

- *£10 billion p.a. in additional profits for manufacturers – a 12% increase in average annual profits.*
- *314,000 new manufacturing jobs - a 12% increase in manufacturing employment.*

- *27 million tonnes of CO2 equivalent p.a. greenhouse gas emissions reduction – 4.5% of the UK's total greenhouse gas emissions in 2010.*”

The document states that the following side-benefits will also accrue:

- *improved security of resources (energy, food and raw materials)*
- *reductions in waste and landfill*
- *less traffic congestion and reduced load on energy and transport infrastructures (requiring less investment)*
- *improved prosperity in UK agriculture (mainly through waste reductions)*
- *economic development in those developing nations supplying UK manufacturers*

The document specifically excludes discussion of ‘labour productivity’ (labour productivity improvements are said to have reduced costs since 2001 at 3% p.a. to £75bn in 2011, a loss of about 1,000,000 jobs).

However, as Air Chief Marshal Sir Sidney Dalton said, “But it is people who turn technology into capability”; the document implicitly recognises the truth of this when it discusses eight barriers to the delivery of these benefits:

- senior executive leadership (strategy, allocation of resources and investments, leadership and impetus for change, etc)
- information (awareness, futurology, technical developments, etc.)
- skills (servitisation, making linear companies cyclic, etc.)
- resources (financial, relevant manpower, etc.)
- design (better design processes & tools, design for recycling, better utilisation of fewer materials, etc.)
- infrastructure (e.g. energy efficiencies, recovery and reuse of materials)
- legal constraints (e.g. bans on remanufactured parts in new goods)
- collaboration (unwillingness to talk to suppliers, security issues, etc)

Amelioration of these barriers involves the direct participation of people, and it here where the knowledge and skills of the ergonomics/human factors profession become significant and useful.

Some process issues emerging from the document

To avoid an abstract discussion, we consider ‘Circular manufacturing’ (the rest of us might call it ‘recycling and re-use’, as a very important means to address sustainability. Figure 1 below illustrates what is meant by this.

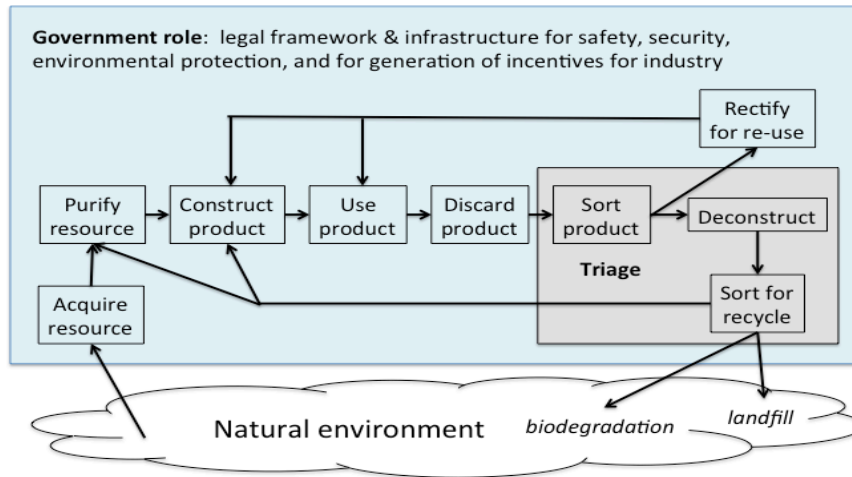


Figure 1: Illustration of 'circular manufacturing'.
See text below for discussion

The intention is both to reduce impact on the environment through mining and landfill, by re-use of materials as much as possible, following the right-to-left arrows above. Triage is of critical importance in this; note that the design of the product has a big impact on the difficulty of materials separation.

More specifically, recycling/re-use includes the following:

- re-use – re-deploying a product without the need for refurbishment – e.g. reselling mobile phones in less developed regions.
- remanufacturing – restoring a product to its original performance. Caterpillar has a successful engine remanufacturing business.
- cascaded use - using a product for a lower value purpose – e.g. turning used clothes into pillow stuffing.
- recycling – extracting a product's raw materials and using them for new products – e.g. aluminium and steel are widely recycled.
- recovery – using a product's materials for a basic, low value purpose such as road base or combustion to produce heat.

As a concrete example of this, consider the Ricoh COMET Circle, shown in figure 2

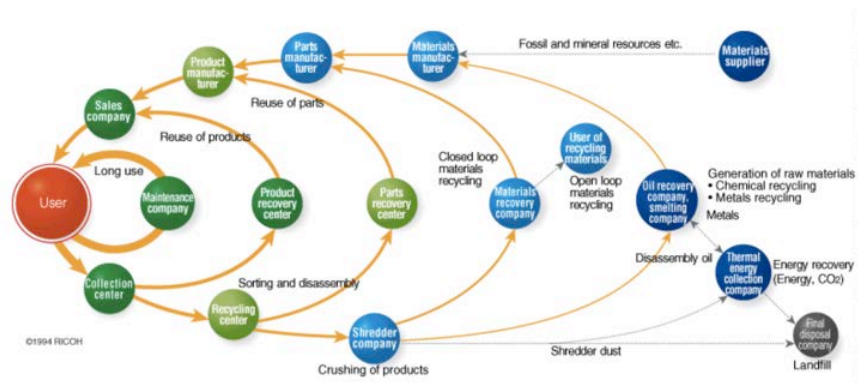


Figure 2: The Ricoh COMET Circle to recycle/ reuse photocopiers. This has resulted in a ‘90% reduction in emissions and waste’.

Ricoh has generated new companies and processes, and a new business model in which they charge by the copy rather than by the machine, since the copiers they supply may be remanufactured rather than new. In fact, the report states that some companies in the UK have been able to reduce waste for landfill to zero.

Implications for the ergonomics of job design

A recent review paper (Zink 2013) summarises a number of changes that will be necessary to meet the new working environment illustrated above, in particular the sustainability aspects. A number of points are made; firstly, the changes in design of the product to use sustainable materials will equally need job redesign that also minimises waste in the job; entropy in the form of heat, emissions, materials waste, tool redesign, task removal or simplification, and so on. These will be in addition to the usual job criteria that ergonomists use.

Secondly, because of the ever-increasing pace of change, driven both by shorter-term drives of competitive advantage and by the longer-term needs of the sustainability agenda, there is an issue of ‘human workability’ (Ilmarinen 2006, Docherty, Kira et al. 2009), defined as having the health, physical, psychological and social functional capacity to do designated work, including professional competence, values and ethics, and understanding of work conditions, work community, supervision, and the characteristics and processes of change.

Thirdly, ‘workability’ in relation to changes entails considerations of ‘employability’. This includes an individual’s ability to gain and maintain employment, to move between roles within an organisation, to obtain new employment in an equivalent role, and to be equipped with the knowledge and skills to do so. Since the latter applies across all employees, employers have a role to play in ensuring collective learning as well; it becomes an organisational skill, particularly in imparting the skills of sustainability. While people may

learn these skills in the workplace, the thinking involved will be useful in other aspects of their lives.

Finally, from an ergonomics perspective, all the issues mentioned above come covered with the complexities arising from the fact that all the people are individual in their hopes, aspirations, and personal histories. Clearly, then, what we as ergonomists normally call 'job design' with its emphasis on health, safety satisfaction and performance will need some reconsideration. It seems that there is a role here for the IEHF to bring about such reconsideration through recommendations for initial professional education and through subsequent Continued Professional Development.

Other implications for ergonomics emerging from this

Whether or not the recycling/ re-use routes indicated in Figs. 1 and 2 happen within one company or within a constellation of smaller companies, they imply a linked set of systems that constitute a 'system of systems', in which people will play an important part. While ergonomics practitioners are skilled in systems ergonomics, there is a requirement for extension of this into systems of systems ergonomics, since these systems of systems have extra characteristics not evident at the systems level (Maier 1998, Dahmann and Baldwin 2008, Firesmith 2010, Barot, Henson et al. 2012, Henshaw, Barot et al. 2013).

Secondly, as implied in the discussion above, there is a large degree of organisational re-arrangement and redistribution of roles, authority, responsibilities and skills involved. Inevitably there will be associated organisational culture changes to be carried through as well; as a manager commented when involved in an organisational shift to a service orientation (similar to Ricoh), "Basically [we] spend [time] explaining to people some of the new skills that we need and some of the new mindset issues about, for example, spares always used to be a profit opportunity, now they're a cost, and that's a completely 180 degree turn for us" (Johnstone, Dainty et al. 2008). There is an evident role for ergonomics skills in accomplishing this, but these skills need the extra knowledge base about this area to make the skills most effective.

Thirdly, there is likely to be a knowledge and culture upheaval in the design and engineering parts of the organisation, both to redesign products, to incorporate recycling considerations, to creating new processes and their associated technology, and creating new jobs. For all of these, there is a role for ergonomics knowledge and skills, especially in the light of creating 314,000 new ones in the UK alone.

Fourthly, given that government involvement will be necessary, both to create a business environment in which private investment will be encouraged and to provide a regulatory environment to protect people, the general environment and the businesses involved, there may be an important role for the IEHF as an institution to provide sound advice to the government of the day.

Finally, for the IEHF to be in a position to fulfil its role in these new aspects of business, it must ensure that its practitioners are equipped to provide the expertise to their clients. There is a role here for Continuous Professional Development and for initial skills training by the educational providers, and for research to develop the new knowledge required. It would be timely for the IEHF Council to consider how this role might be fulfilled.

It would be nice to think that the IEHF will be ensconced comfortably on the sustainability bandwagon of the future, rather than trailing in its dust, catching up with it.

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