

SMART ERGONOMICS

Practical application of an ergonomics programme: Construction Sector

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Overview



1. What is ergonomics?

2. What is an ergonomics program?

3. A program approach to implementing ergonomics:
Construction case study

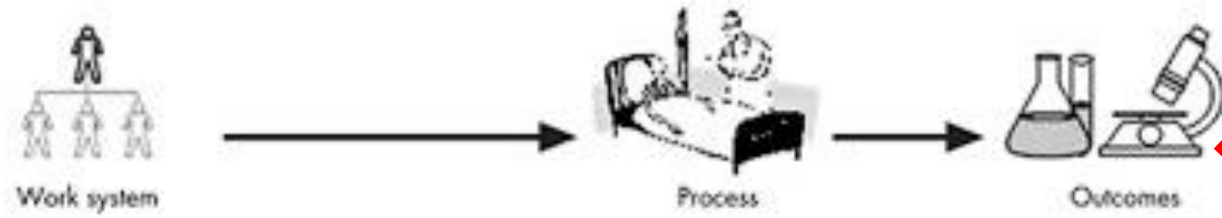
4. Conclusions

5. Q & A

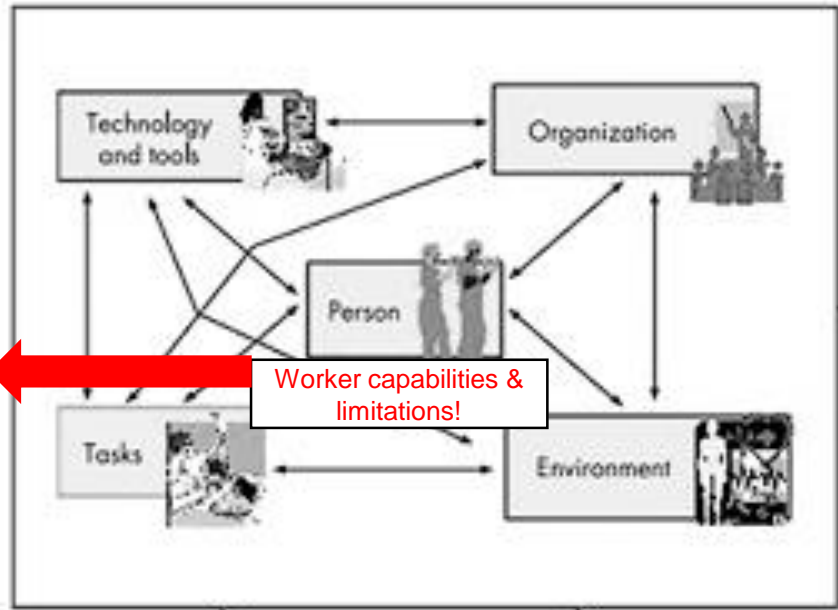
What is ergonomics: Complex Sociotechnical Systems & Interactions



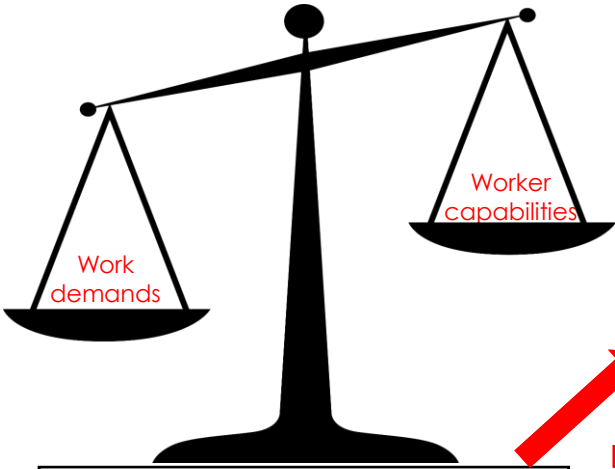
Complex socio-technical work systems



- OPTIMAL SYSTEM INTERACTIONS**
- Productivity
 - Quality
 - Safety
 - Health



- SUBOPTIMAL SYSTEM INTERACTIONS**
- Inefficient production
 - Suboptimal quality
 - High workload, fatigue, stress
 - Absenteeism, presenteeism, high turn-over
 - Occurrences (near misses, incidents, injuries, accidents)



Sub-optimal Interactions are the source of ergonomic risks!

- Anthropometric
- Biomechanical
- Cardiopulmonary
- Perceptual
- Cognitive
- Social

Worker capabilities & limitations!



Impact of exposure to ergonomic risks in the workplace



CONSEQUENCES OF POOR DESIGN & HFE RISKS IN WORK SYSTEMS (i.e. not considering HFE principles)

- The **effects of poor design** that might impact on **worker health** and **safe operations** include the following:
 - impaired cognitive functioning – reduced concentration and vigilance, irritability and confusion;
 - impaired vision;
 - changes in reaction time;
 - burnout, stress and fatigue;
 - drowsiness (even with proper rest);
 - **Musculoskeletal disorders** (e.g. lower back pain), vascular and neurological disorders;
 - unsafe work practices; and
 - noise induced hearing loss
 - occurrences
 -



<http://rocheinjuryclinic.com/back-pain/>



<https://www.go-law.co.uk/a-ticking-workplace-time->

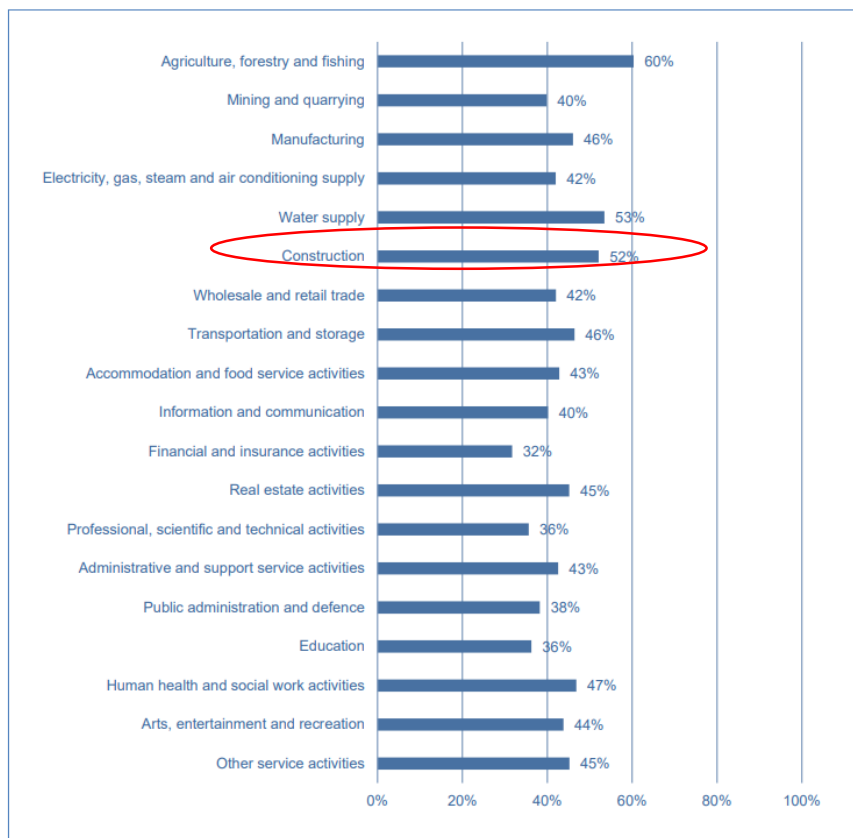


<https://www.bics.org.uk/the-hse-are-shining-a-light-on-musculoskeletal-disorders/mads/>

Ergonomics-related consequences in construction: MSD example

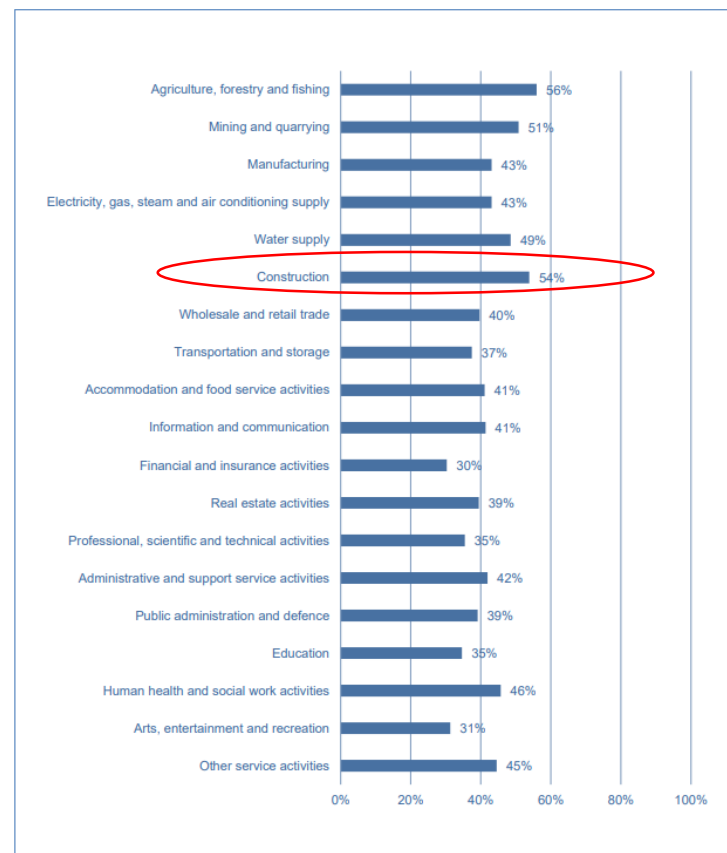


Figure 20 Percentage of workers reporting backache in the past 12 months, by sector (Statistical Classification of Economic Activities in the European Community, NACE, rev. 2), EU-28, 2015



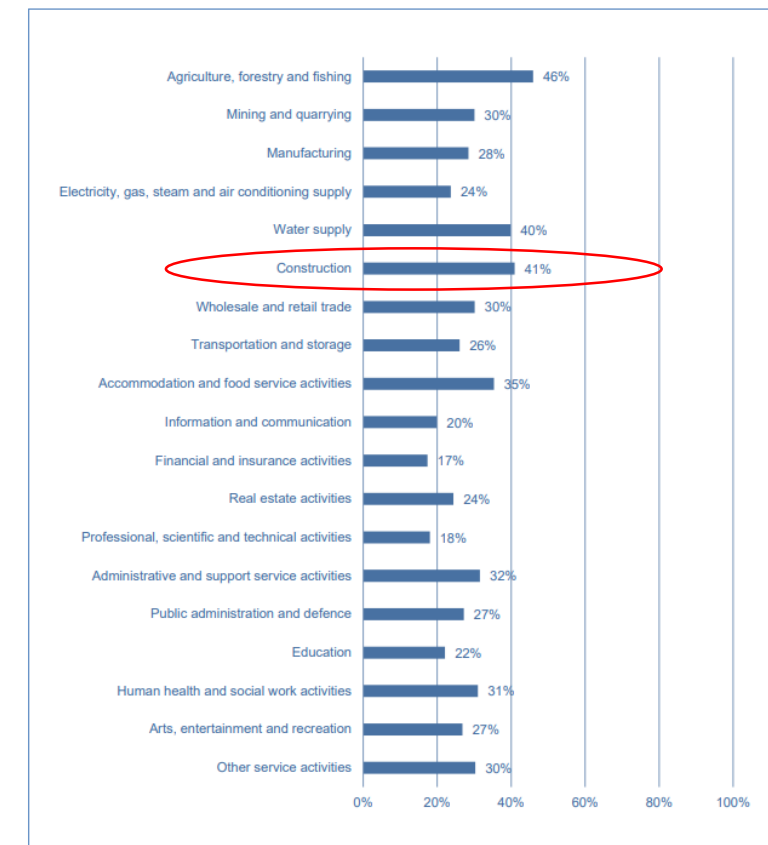
N = 35,536

Figure 21 Percentage of workers reporting MSDs in the upper limbs in the past 12 months, by sector (NACE rev. 2), EU-28, 2015



N = 35,536

Figure 22 Percentage of workers reporting MSDs in the lower limbs in the past 12 months, by sector (NACE rev. 2), EU-28, 2015



N = 35,536

Ergonomics-related consequences in construction: MSD example

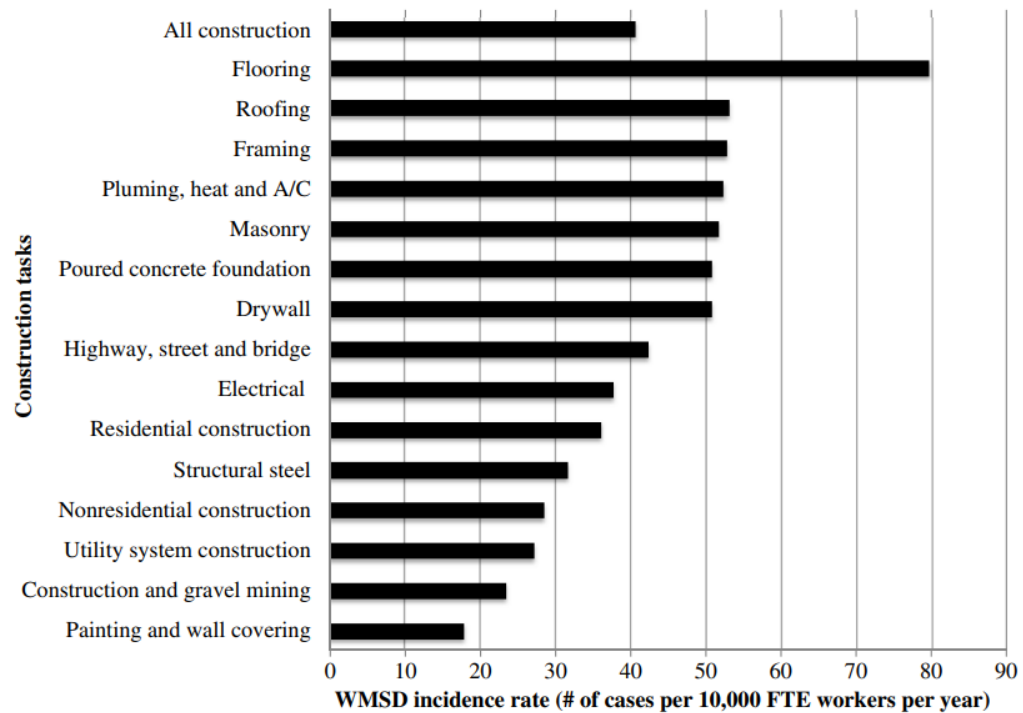


Fig. 1. WMSD incidence rates of typical construction tasks, 2011 forward (data from BLS 2014)

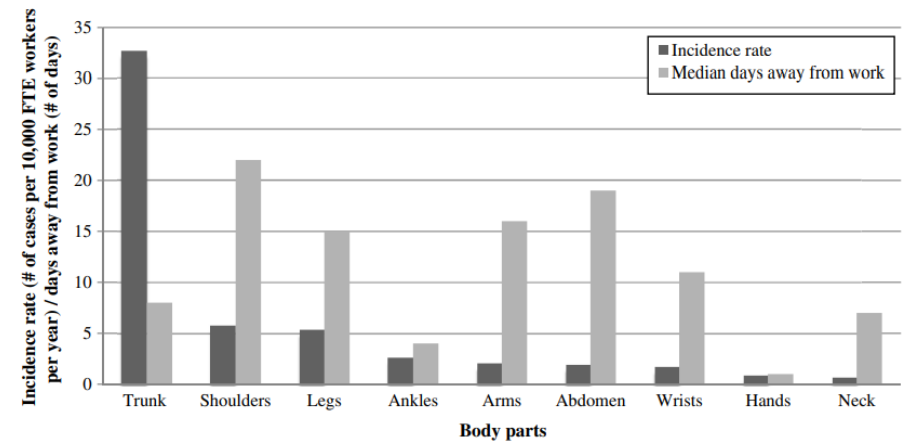
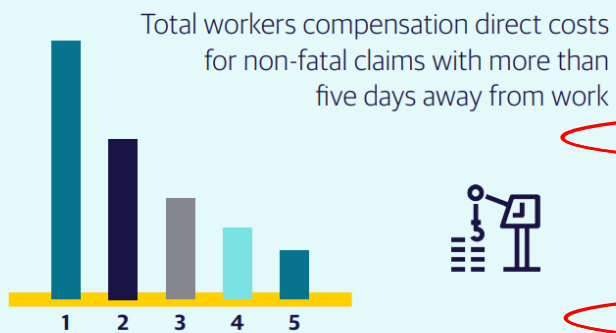


Fig. 2. Distribution of WMSD incidence rates and days away from work by body parts in private industry, West Virginia, 2012 (data from BLS 2013c)

Ergonomics-related consequences in construction: MSD example



	Cost billions	Percent total	
1.	\$3.56	33.8%	Falls to lower level
2.	\$2.21	21.0%	Overexertion involving outside sources (handling objects)
3.	\$1.40	13.2%	Struck by object or equipment (being hit by objects)
4.	\$0.99	9.4%	Falls on same level
5.	\$0.67	6.4%	Other exertions or bodily reactions

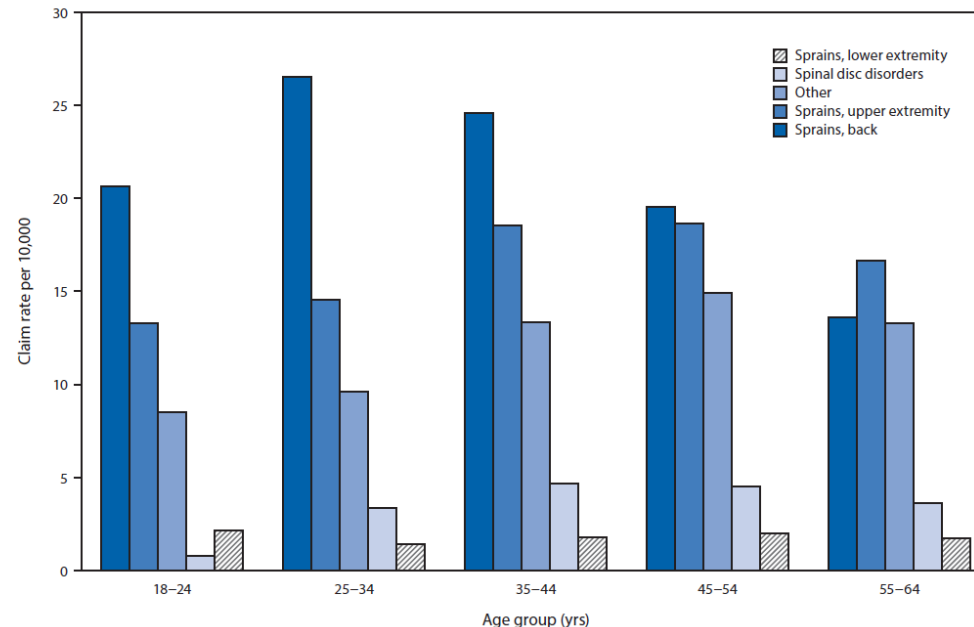


Top 5 injury causes account for \$8.8 billion and represent 83.8% of all injuries in the construction industry annually

Top injury causes

- Overexertion involving outside sources** (handling objects) continues to rank first among the leading causes of disabling injuries. This event category includes injuries related to lifting, pushing, pulling, holding, carrying, or throwing objects. Overexertion costs businesses \$13.30 billion in direct costs and accounts for 22.7 percent of the overall national burden.
- Falls on same level** ranks second, with direct costs of \$10.58 billion, and accounts for 18.1 percent of the total injury burden.
- Falls to a lower level** ranks third at \$6.26 billion and 10.7 percent of the burden.
- Struck by object or equipment** (being hit by objects) ranks fourth at \$5.61 billion and 9.6 percent.
- Other exertions or bodily reactions**, which include bending, reaching, twisting, climbing, crawling, kneeling, sitting, standing, walking, and running, rank fifth at \$4.71 billion and 8.0 percent of the total injury burden.

FIGURE. Rate of work-related musculoskeletal disorder claims from overexertion per 10,000 full-time employees among construction workers, by diagnosis category* and age group — Ohio, 2007–2017



* Among these, 63% were single diagnoses. For multiple diagnoses, an algorithm was used to identify the diagnosis most limiting the ability to return to work.

Kaur, Harpriya & Wurzelbacher, Steven & Bushnell, P & Grosch, James & Tseng, Chih-Yu & Scholl, Juliann & Meyers, Alysha & Lampl, Michael. (2021). Workers' Compensation Claim Rates and Costs for Musculoskeletal Disorders Related to Overexertion Among Construction Workers - Ohio, 2007-2017. MMWR. Morbidity and mortality weekly report. 70. 577-582. 10.15585/mmwr.mm7016a1.

SA construction MSD related risks are prevalent, workers are affected but (successful) claims are very low!

Ergonomics-related consequences in construction: MSD example



Government								
Regulatory bodies and associations								
Company								
Management	Functional: Job Design	Interpersonal: Low supervisor support	Interpersonal: Supervisory methods	Interpersonal: Low co-worker support	Temporal: High efforts & low rewards	Temporal: Organisational change	Temporal: Work scheduling	Temporal: Limited breaks
Staff	Demographics: Occupation	Demographics: Gender	Demographics: Marital and family status	General health, prior pain and co-morbidities: Headaches	General health characteristics: High BMI	Health behaviours: Physical activity outside of work	Worker perceptions: Low job security	Worker strain and recovery: Recovery after work
	Demographics: Age	Demographics: Education level	General health characteristics: History of MSDs	General health characteristics: Health problems	Health behaviours: Smoking	Individual psychological factors: Personality variables	Worker perceptions: Lack of opportunities for career development	Worker strain and recovery: High stress or strain
	Demographics: During of employment	Demographics: Ethnicity and country of origin	General health characteristics: Physical capacity	General health characteristics: Sleep issues	Health behaviours: Alcohol consumption	Individual psychological factors: Depressive or emotional symptoms	Worker perceptions: Value workers place on promotion	
Work	Ambient conditions: Cold temperatures	Equipment: Keyboard positioning	Equipment: Telephone rests	Equipment: Extended computer use	Equipment: Screen height	Postures: Awkward postures	Postures: Prolonged standing at work	Task factors: Heavy physical work
	Ambient conditions: overall work environment	Equipment: Extended mouse use	Equipment: Exposure to vibration	Equipment: Extended keyboard use	Equipment: Chair design	Postures: Working with hands above shoulders	Postures: Prolonged work in sedentary/static positions	Task factors: Repetitive and precision work
		Equipment: Desk height	Equipment: Workstation design	Equipment: Mouse positioning		Postures: Neck flexion		

Summary of the evidence identified through the review and prototype classification scheme. Note that the shading represents the level of evidence associated with each risk factor identified in the review. A **shaded box with bold outline** indicates strong evidence; a **shaded box with bold dashed outline** indicates consistent findings from more than one study; a **shaded only box** indicates limited evidence (i.e. one study); and an **unshaded box with a regular outline** indicates that evidence varies. Risk factors with evidence of no association with increased risk of WMSDs are not represented on the diagram (Goode et al., 2019)

Ergonomics-related risks and consequences are systemic but manifest at the sharp end



<https://ecasa.co.za/publications/carrying-people-on-construction-vehicles-is-a-violation-of-regulations/>



Figure 7 Examples of large vehicles and poor operating access / egress



7(a) Awkward climb required to access crawler excavator

7(b) High step and climb



7(c) Steps and handholds requiring strength and balance!



https://www.researchgate.net/publication/305075346_Slips_trips_falls_and_other_risks_when_accessing_egressing_or_working_upon_workplace_transport (Images courtesy of Lafarge)

HF/E LEGAL REQUIREMENTS



All legislation that affects workers and how work and work systems in industry are designed, organised, implemented, and managed should incorporate HF/E considerations!

Occupational Health & Safety Act 85 of 1993

General duties of employers to their employees

8. (1) Every employer shall provide and maintain, as far as is reasonably practicable, a working environment that is safe and without risk to the health of his employees.

(d) establishing, as far as is reasonably practicable, what hazards to the health or safety of persons are attached to any work which is performed, any article or substance which is produced, processed, used, handled, stored or transported and any plant or machinery which is used in his business, and he shall, as far as is reasonably practicable, further

55

Compensation for Occupational injuries And Diseases Act

- Workers compensated for disablement caused by exposure to occupational risk factors
- Disorders include
 - Loss of sensory functional capacity (hearing, sight, exposure to vibration leading to hand-arm vibration syndrome etc.
 - Loss of limbs
 - Any disease resulting from overstraining of muscular tendonous insertions e.g. Work related upper limb disorders

HF/E LEGAL REQUIREMENTS



Construction Regulations of 2014

Risk assessment for construction work

9. (1) A contractor must, before the commencement of any construction work and during such construction work, have risk assessments performed by a competent person appointed in writing, which risk assessments form part of the health and safety plan to be applied on the site, and must include—

- (a) the identification of the risks and hazards to which persons may be exposed to;
- (b) an analysis and evaluation of the risks and hazards identified based on a documented method;
- (c) a documented plan and applicable safe work procedures to mitigate, reduce or control the risks and hazards that have been identified;
- (d) a monitoring plan; and
- (e) a review plan.

(2) A contractor must ensure that as far as is reasonably practicable, ergonomic related hazards are analyzed, evaluated and addressed in a risk assessment.

Ergonomics Regulations of 2019

	INTRODUCTION
REGULATION 2	Scope of Application
REGULATION 3	Information, Instruction and Training
REGULATION 4	Duties of those who may be at risk of exposure to ergonomic risks
REGULATION 5	Duties of Designers, Manufacturers, Importers and Suppliers
REGULATION 6	Ergonomics Risk Assessment
REGULATION 7	Risk Control
REGULATION 8	Medical Surveillance
REGULATION 9	Maintenance of Controls
REGULATION 10	Records
REGULATION 11	Ergonomics Health and Safety Technical Committee

ERGONOMICS PROGRAMS



- What is the difference between an ergonomics program and ergonomics intervention?

ERGONOMICS INTERVENTIONS

ERGONOMICS PROGRAMS

- Usually done at a smaller scale and are aimed at solving a specific problem or situation where a limited number of workers and workstations are affected
- Usually reactive in nature
- Small scale interventions may incorporate selected elements of an ergonomics program
- Others may refer to the introduction of an ergonomics program as an intervention



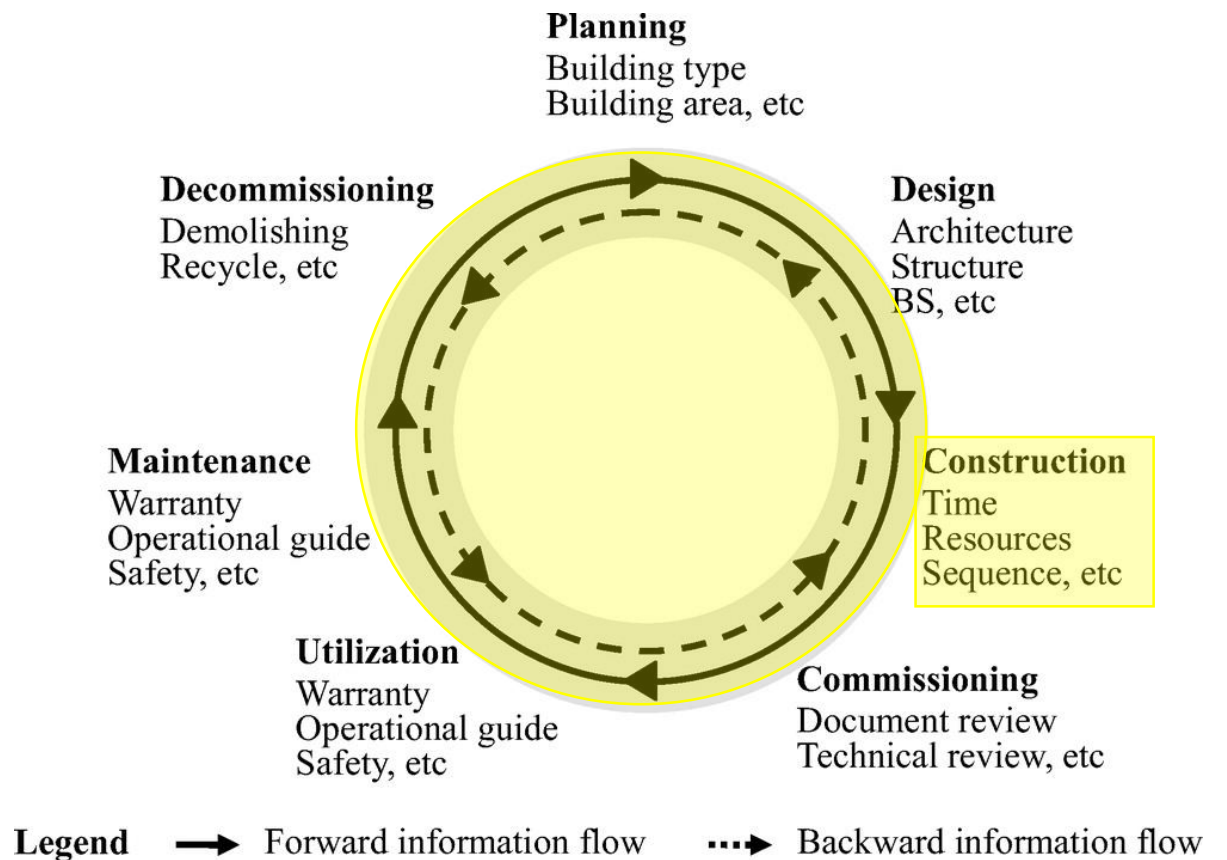
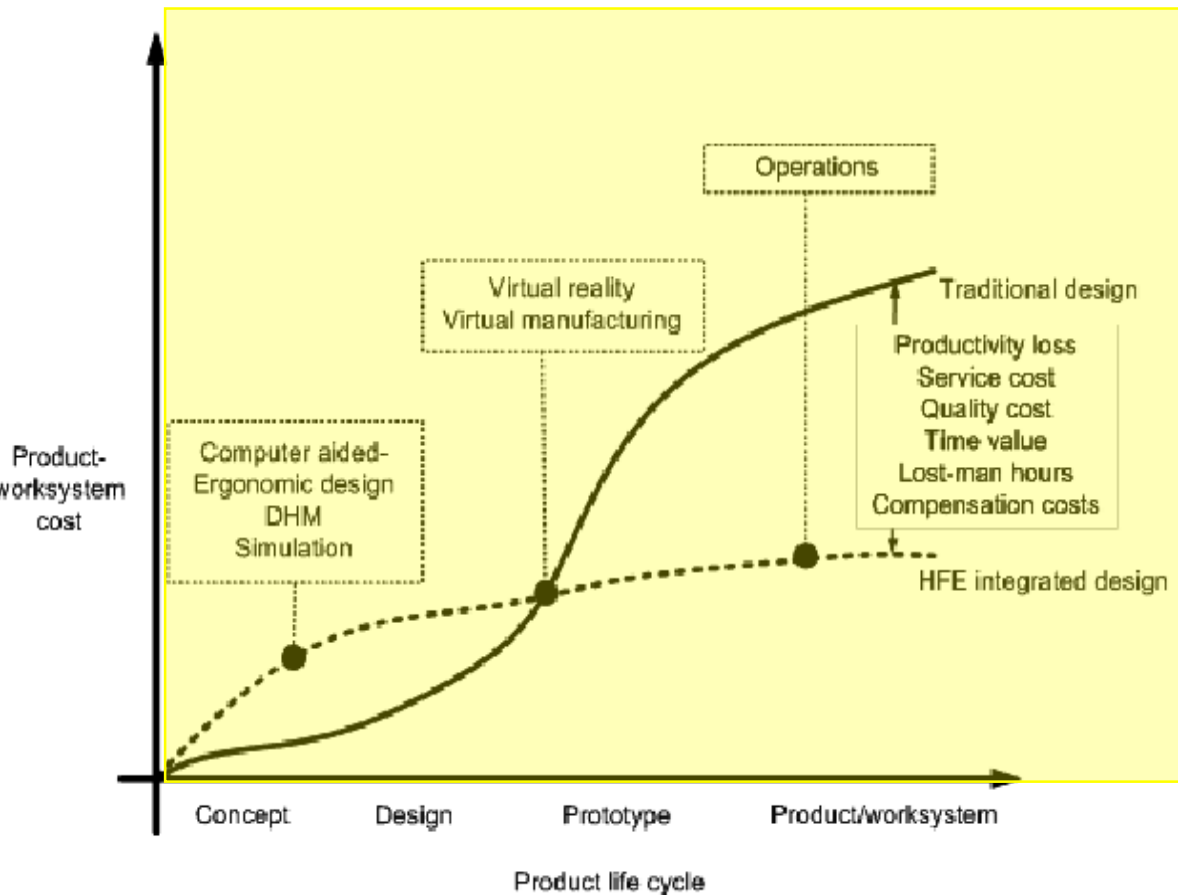
- Systematic approach for anticipating, identifying, analysing, and controlling ergonomic risks (Ergonomics Regulations: 2019)
- Used in company-wide implementation of ergonomics to solve problems that affect multiple workers and workstations (should not be regarded as separate to other organisational programs aimed at managing occupational risks within work systems)

ERGONOMICS PROGRAMS



- What is the difference between an ergonomics program and ergonomics intervention?

ERGONOMICS INTERVENTIONS VS PROGRAMS ACROSS LIFE CYCLE STAGES



ERGONOMICS PROGRAMS



- What is the difference between an ergonomics program and ergonomics intervention?

ERGONOMICS PROGRAMS

- Best practice = ergonomics program
- Ergonomics regulations recommend a program approach in the explanatory notes which are intended to give practical insight into the application of the Regulations
- Consider organisation's stance on risk management

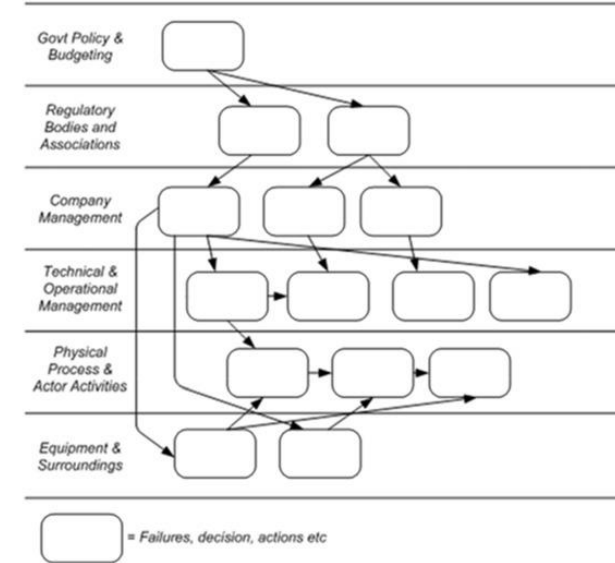
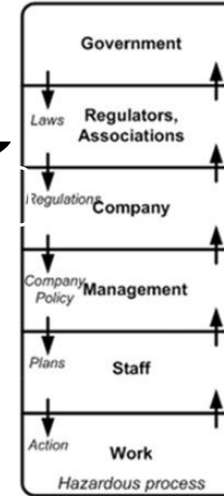
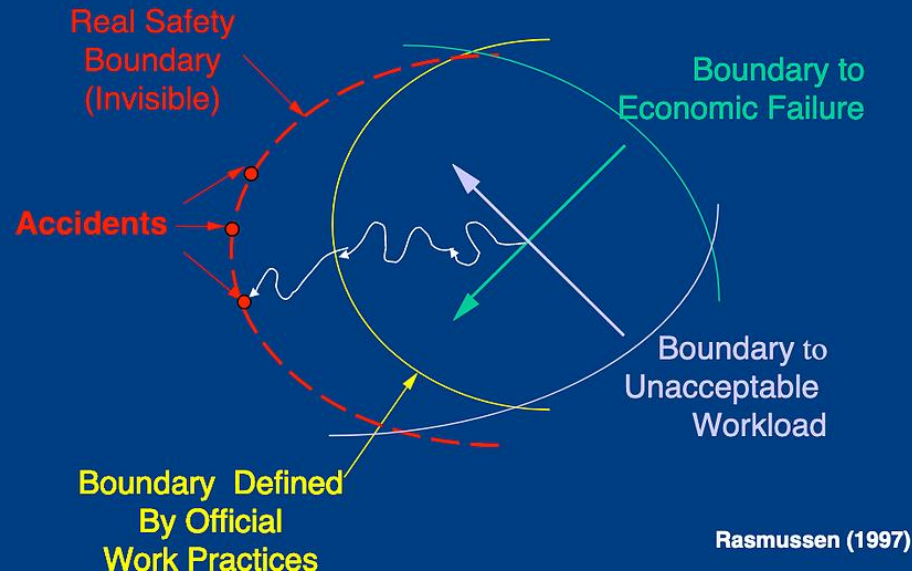
The regulations speak to an ergonomics programme approach which should be integrated into existing occupational health and safety programmes. An ergonomics programme is a systematic process for anticipating, identifying, analysing and controlling ergonomic risks, which should include but not be limited to, ergonomics hazards identification and risk assessment, risk controls, information and training, monitoring and evaluation and medical surveillance. It is important to acknowledge that ergonomics is not a stand alone hazard, but rather part of the broader approach to ensuring a workplace that is safe and without risk to the health of employees as well as productivity at work.

Ergonomics program: system-wide implementation of ergonomics



1. Understand the context (task observation, task analysis, document review, worker interviews etc.)

Understanding the context requires an understanding of work systems and worker performance



COMPLEX SOCIO-TECHNICAL SYSTEM

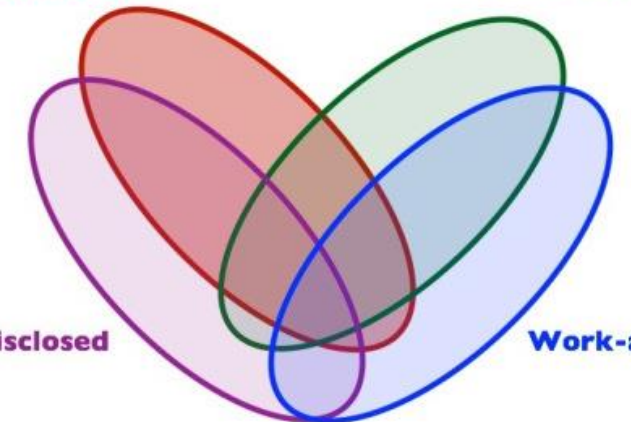


Work-as-Imagined

Work-as-Prescribed

Work-as-Disclosed

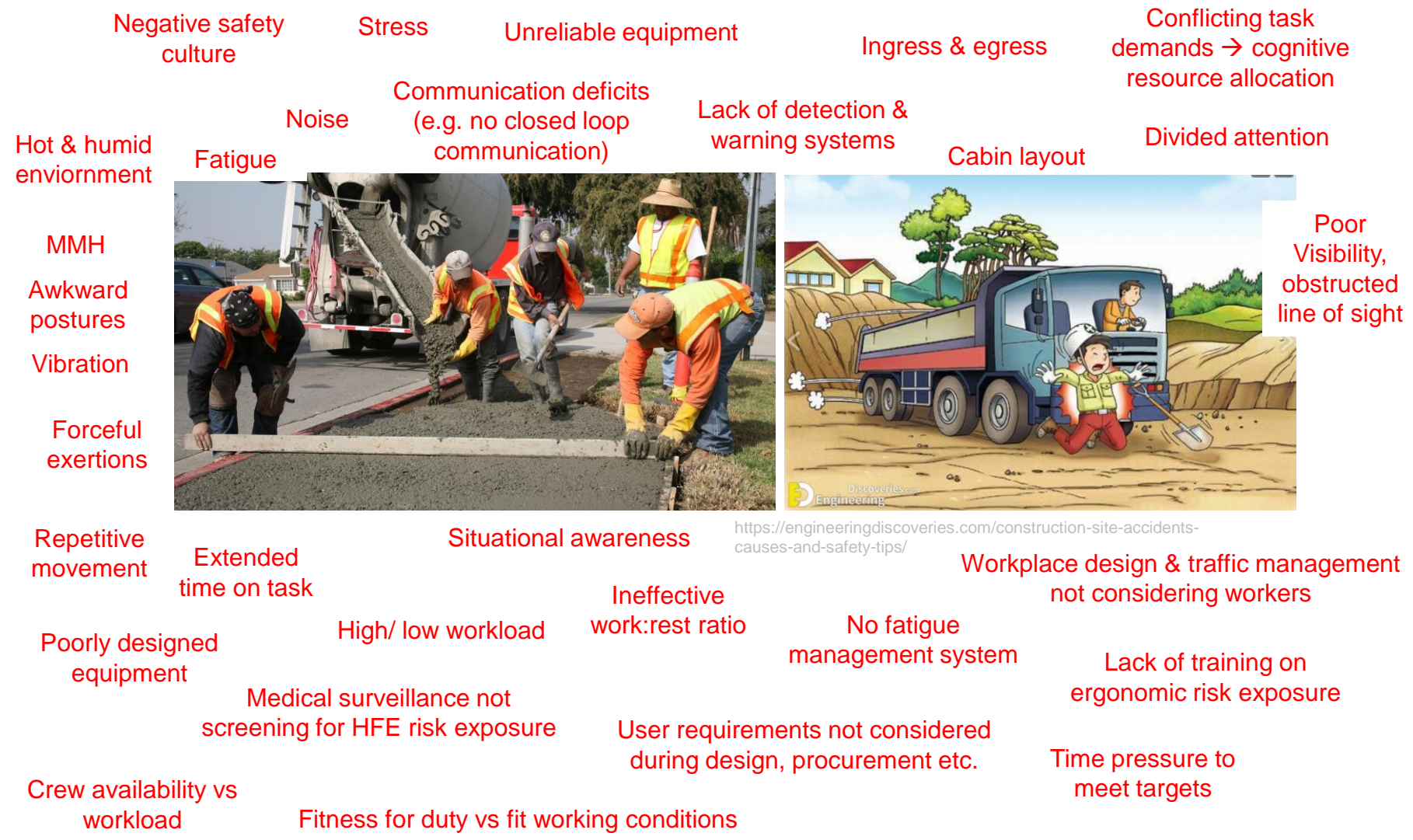
Work-as-Done



Ergonomics program: system-wide implementation of ergonomics



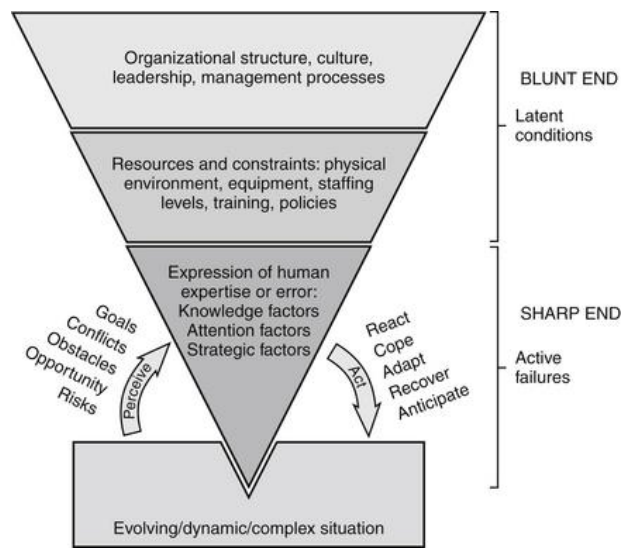
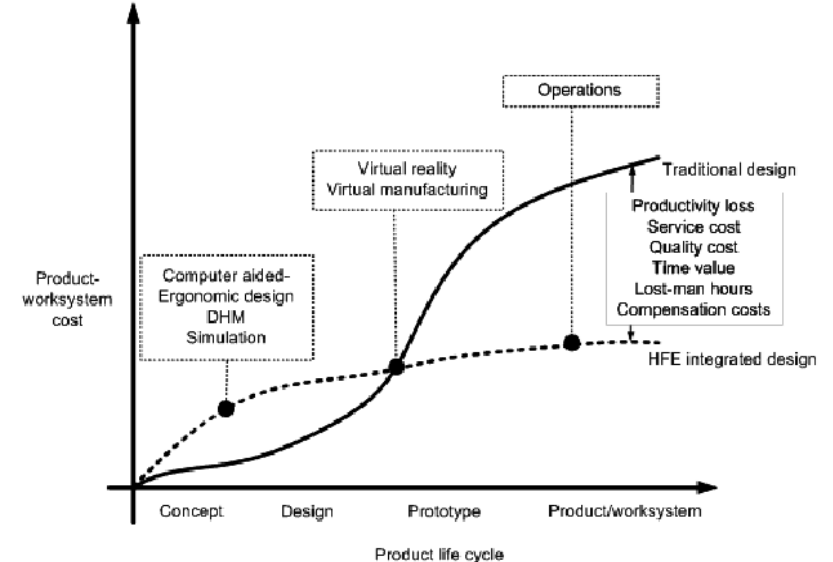
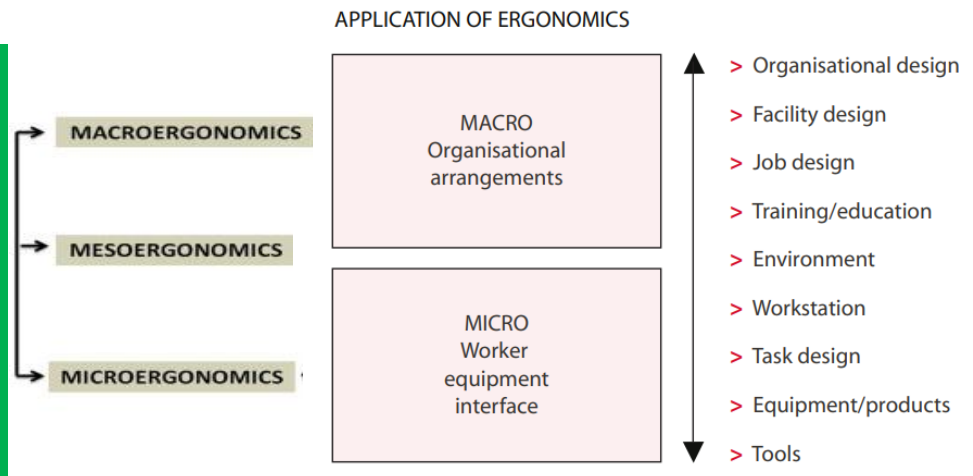
1. Understand the context (task observation, task analysis, document review, worker interviews etc.)
2. Comprehensive hazard identification
3. Develop appropriate toolbox of suitable risk assessment tools considering assessment at micro vs macro levels, level 1- level 3 tools)
4. Assess ergonomic risks (i.e. sub-optimal interactions) across the system and organisational processes and levels



Ergonomics program: system-wide implementation of ergonomics



1. Understand the context (task observation, task analysis, document review, worker interviews etc.)
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5. Develop appropriate controls
6. Implement and maintain controls

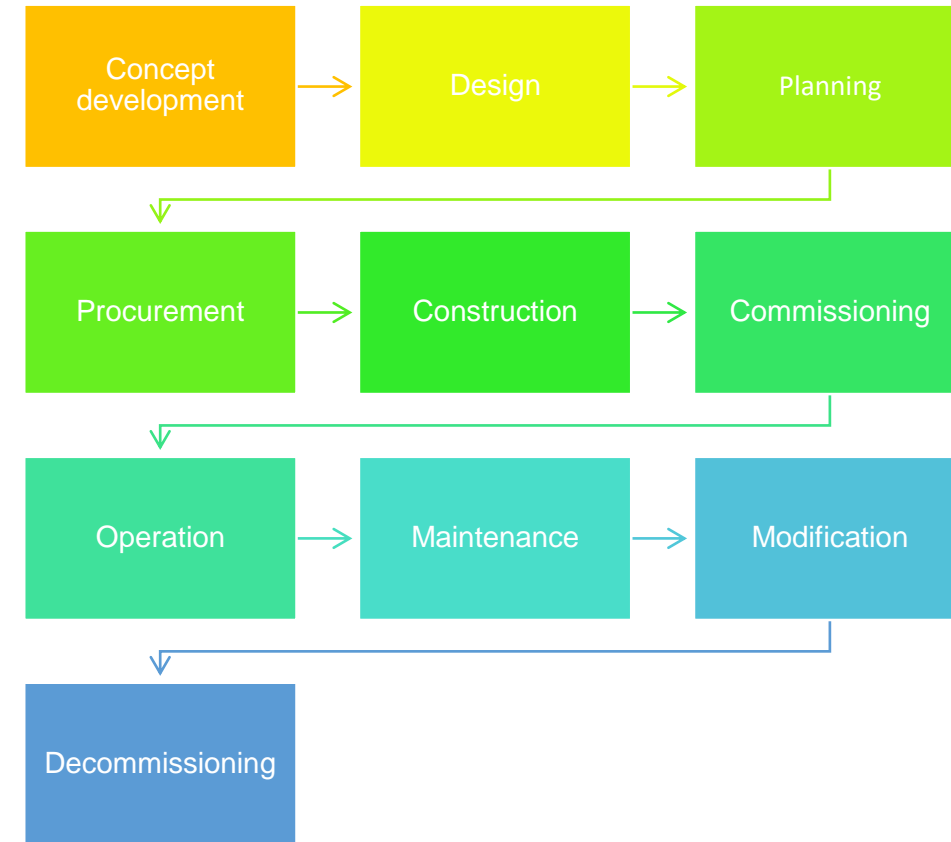


Ergonomics program: system-wide implementation of ergonomics



Integration of ergonomics across all organisational processes & life cycle phases

1. Understand the context (task observation, task analysis, document review, worker interviews etc.)
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5. Develop appropriate controls
6. Implement and maintain controls
7. Monitor and review effectiveness of controls



Integration of ergonomics across SMS, all organisational processes & life cycle phases & stakeholders affected



Engineering

- Design for user: Products & systems optimised for users by considering mental and physical capabilities & limitations
- Get user inputs into designs from concept stage

Procurement

- Ensure that specifications for the procurements of services, products and systems incorporate user requirements
- Procure HF/E service providers that are competent

Workers & unions

- Make inputs and provide feedback on the impact of HF/E risk exposure
- Participate in the development of effective controls

Health, risk practitioners, internal auditors

- Incorporate HF/E risks in all risk management processes (baseline RA, OREPS, post accident...)
- Ensure that relevant assessment or surveillance of HF/E risk exposures are conducted periodically
- Training of workers on HF/E related risk exposure, their effects, and controls

Training & development

- Training should be aligned to work requirements (technical and non-technical skills)
- Training on HF/E to be provided for workers

Management & HR

- Consider the impact of decisions on manifestation of HF/E risks (e.g. staff cuts, shift changes etc)
- Policies, processes & procedures to incorporate HF/E requirements

Recruitment and selection

- Get input from workers and supervisors on task requirements from performance perspective as well
- Ensure that tests and assessments that are used consider screening for physical and cognitive capabilities & limitations
- Calculation & filling of vacancies based on appropriate fatigue, workloa, and safety considerations

Medical Surveillance

- Include the screening and management of medical and psychological disorders and diseases emanating from HF/E related deficiencies (MSD program)
- Training workers, management on exposure to HF/E related risk factors and impact on health

Ergonomics program: system-wide implementation of ergonomics



1. Understand the context (task observation, task analysis, document review, worker interviews etc.)
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4. Assess ergonomic risks (i.e. sub-optimal interactions) across the system and organisational processes and levels
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Key Elements	Successful ergonomic program
Management	<i>Can be effective by:</i>
	Focusing the employer's belief on necessity of ergonomics program
	Appointing persons in charge for ergonomic program execution
Training	Establishing goals
	Increasing knowledge of ergonomic
	Improving skills & abilities in reducing ergonomic hazards
Employee participation	Enhancing job satisfaction
	Enhancing motivation
	Creating team
	Improving communication
Program evaluation	Auditing of targeted performance
	Evaluating of program efficiency
Development of solutions	Ergonomic hazards identification
	Controlling development to mitigate hazards
	Appropriate engineering
	Appropriate work practice controls
	PPE (Personal Protective Equipment)
	Administrative controls

Barriers to integrating ergonomics across life-cycle phases of construction projects



- Lack of ergonomics awareness (all levels/ stakeholders in an organisation)
- Insufficient HFE capacity within the organisation
- Cost of implementing ergonomics (but what is the cost of not implementing?)
- Production pressures in a highly competitive environment
- Short-term nature of some projects vs effective management of short and long-term risks to workers
- Safety management fragmented, not system focused
- Dynamic working conditions (Work on different sites, different construction requirements, seasonal workers)
- Malicious compliance
- Resistance to change
- Safety is a “priority” (as long as it does not affect productivity and costs)

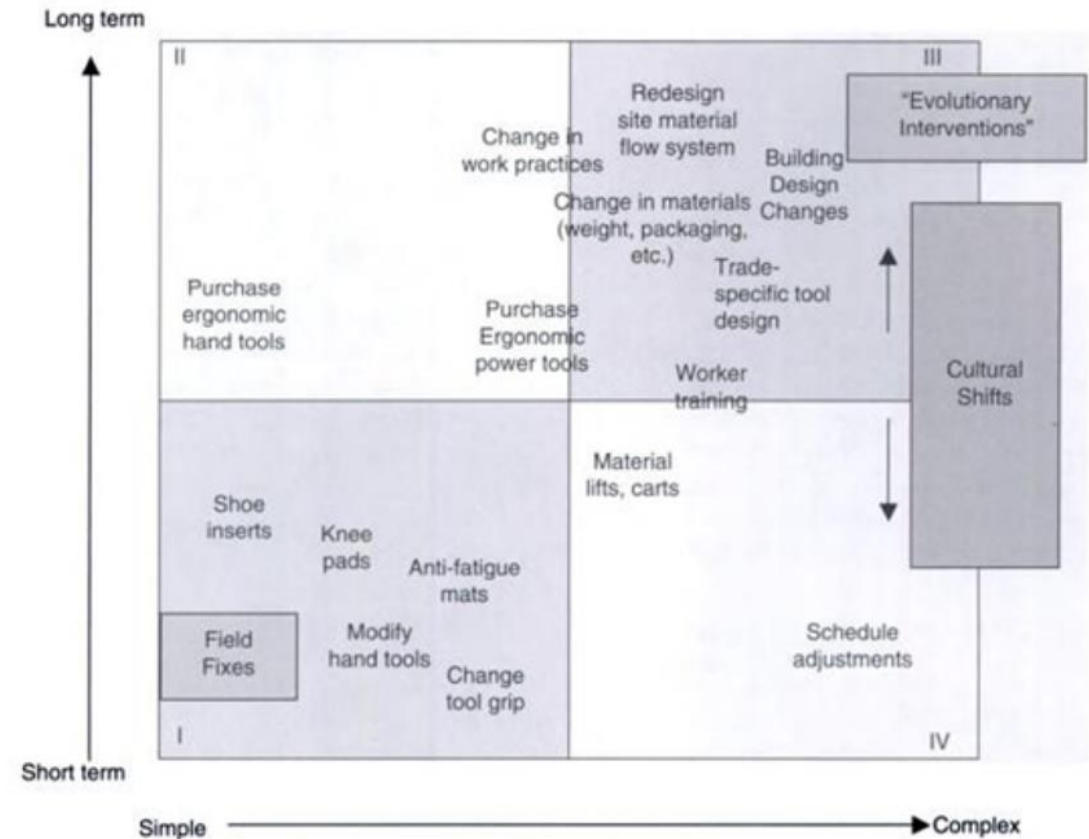


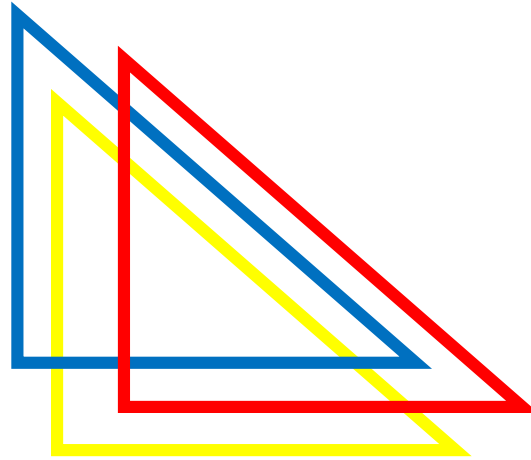
FIGURE 50.10 Construction ergonomics intervention matrix.

CONCLUSION



- Organisations need to have a comprehensive ergonomic risk management program in order to effectively manage ergonomic risks and comply with legal and regulatory requirements
 - Effective HF/E management requires a consolidated approach where all relevant HF/E factors are considered and complex interactions are understood
 - Understand work system and all its elements (workers, tasks, tools/equipment, organisational factors and the physical working environment)
 - Education and awareness is critical
 - Managing HF/E is a dual responsibility between personnel and the organisation, look at options to build ergonomics capacity internally for more sustainable ways of implementation of ergonomics
 - Managing HF/E requires multidisciplinary stakeholder involvement and participatory approach (get workers and other stakeholders involved)

THANK YOU FOR YOUR ATTENTION



SMART ERGONOMICS

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