

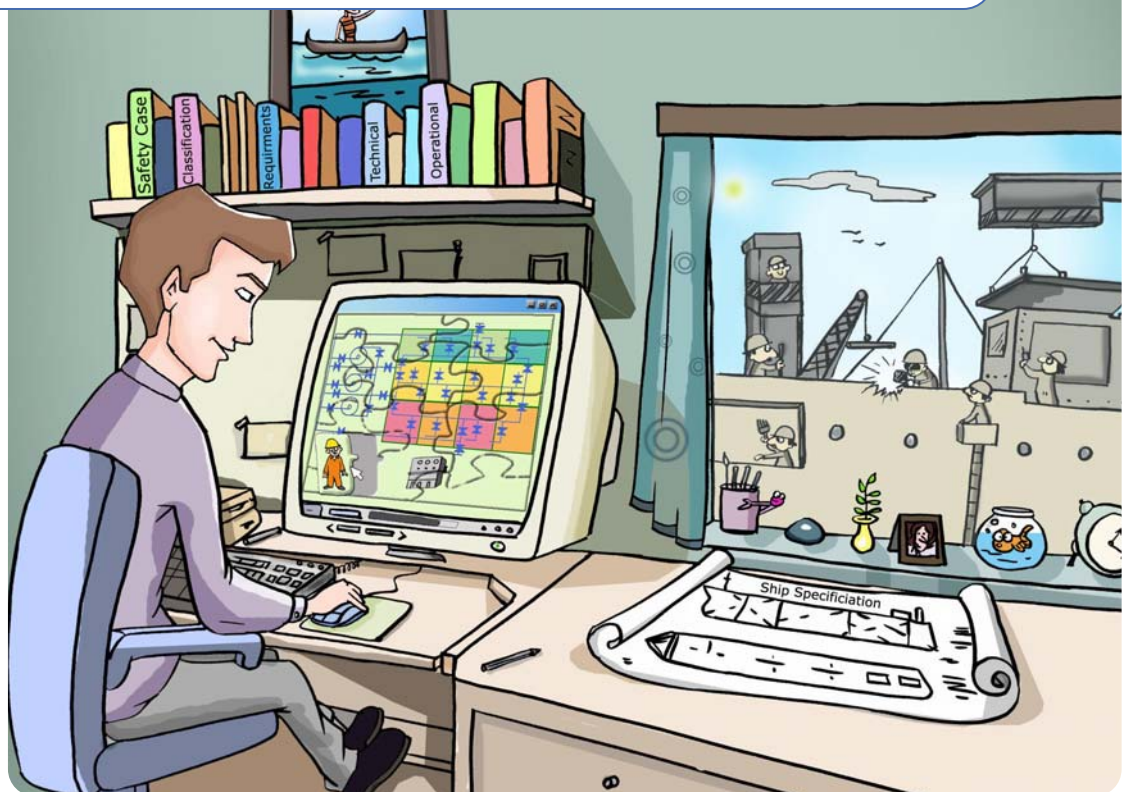
Human-centred development

Putting the principles into practice

This guide provides suggestions on how to acquire or develop something in a human-centred way.

Used appropriately, it will support effective management of human element issues.

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Summary

This guide is intended to assist in the consideration of human-system issues in the acquisition of development of new or revised procedures, training, equipment and software. It describes the four activities through which information about people is collected and used in design and how the product is evaluated.

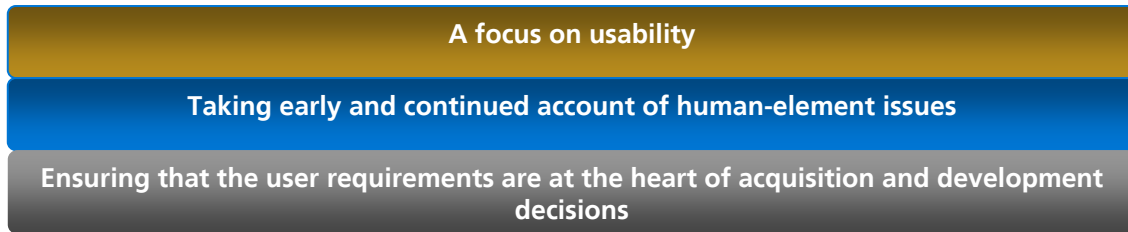
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What does human-centred development mean?



Users include:

- End users; and
- People supporting or maintaining a product throughout its life.

"Products" refer to anything being acquired or developed, ashore or at sea:

- 'Hardware' such as ships and equipment; and
- 'Software' such as procedures, policies, checklists, manuals and training.

The users' needs and characteristics are specifically considered in decisions and trade-offs, along with engineering, production, commercial and operational considerations.

The usability of a product is treated as vital to it achieving its aims, and therefore supporting both the user and the company.

Being human-centred is a crucial aspect of properly addressing human element issues. Four main principles guide the process:

1. Continuous improvement; learning from experience, trials or prototypes;
2. Early, continuing, effective crew input;
3. Matching of procedures and systems to people and tasks;
4. Teamwork and co-operation between stakeholders.

When should the principles be applied?

When developing anything that involves people – shore staff and seafarers.

When acquiring products developed elsewhere.

When developing something new, or amending something existing.



Throughout the life of a ship, right from the beginning of specification, through design to operation and disposal.

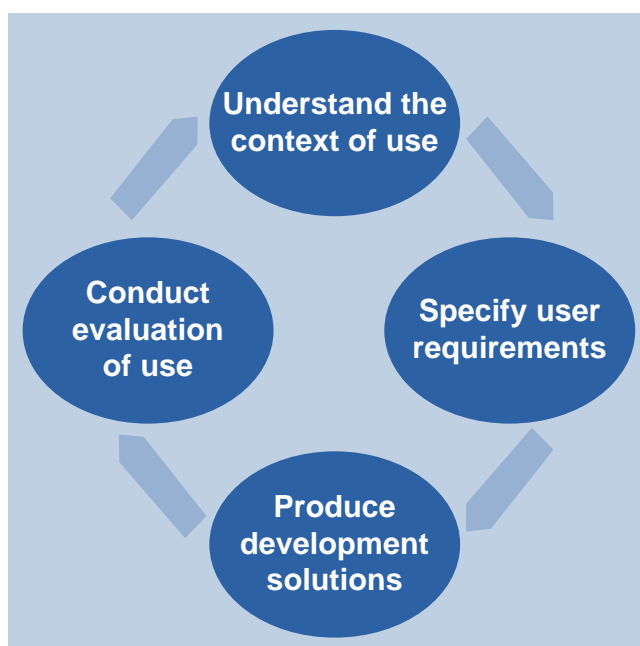
Throughout the life of a product, not just at the start of the development process. Improvement through feedback from users is crucial. The project plan must allow time and resources for changes resulting from user input.

Who should be involved?

Applying the principles thoroughly will usually require action from different departments, including representatives of different disciplines.

Human-centred development cannot be carried out properly as an isolated process, either in time or departmental involvement.

The principles must be applied from the start of an acquisition or development, so that the appropriate activities can be carried out at the appropriate points.



What does it involve?

There are four activities in human-centred development, as shown on the left.

Although these activities are usually carried out in the sequence shown they should not be seen as a life cycle of as forming a single bounded set of steps, but a family of processes to be applied as required by a company or project.

What are the benefits of human-centred development?

- Makes products easier to use and understand, reducing training and support requirements, as well as the risk of error in use.
- Improves user satisfaction with products, reducing discomfort and stress, and reducing the likelihood of violations.
- Improves the efficiency and productivity of users of products, the tasks that these products support, and ultimately the whole company.

- Improves the effectiveness of, and compliance with, procedures and instructions through involvement of the users during acquisition or development.
- Helps you meet company obligations to protect users of products from risks to their health and safety.

Advantages will be seen throughout the life of a product, from a more complete definition of requirements to easier or even reduced through-life support and maintenance.

Who should use this guide?

All those involved in the acquisition or development of all products within a ship operator, whether those products are hardware or software, large or small.

All those involved in the design, development and supply of products to be used by a ship operator.

Some companies may find it easier if one person is responsible for coordinating putting the principles of human-centred development into practice for each individual product. However, for the full benefits to be realised, all the departments and stakeholders involved must take part, including third party suppliers where appropriate.

These stakeholders are likely to include staff and managers in departments or projects, whether ashore or onboard ship, who make use of, have an effect on, or are affected by, the product being developed. The wider system must be considered, including aspects such as associated training, documentation, familiarisation, risk of human error, commercial pressures and related tasks.

How should the guide be used?

Each section covers one of the four activities with a list of prompt questions. You should ask yourself these questions to see how they apply to the product you have in mind. This will help you to apply the principles of human-centred development in a systematic way. Below each question are some pointers for things to consider when trying to answer it.

For large, complex, business or safety-related products all activities should be applied in a rigorous manner. For more simple, less business or safety-related products it is possible to reduce the rigour of application. The activities are not necessarily time-consuming. In some cases, for example revising a procedure, it may be possible to carry out all activities in a few hours. In all cases carrying out the activities will increase quality and save time and money in the long run.

Why has Lloyd's Register published this guide?

To help ship operators and others take effective account of human element issues when designing and developing their ships, equipment, policies, procedures, etc.

Human element issues are the major source of risk in shipping. Lloyd's Register offers this guide as a source of advice in managing human element issues throughout companies, fleets and the support industry including suppliers.

It can be used on its own, or to help guide particular improvements that may be required following a comparison of a company's practices against the Lloyd's Register publication, *The Human Element – Best Practice for Ship Operators*. This comparison could involve an informal self-assessment, or a formal Human Element Gap Analysis carried out by Lloyd's Register.

The Human Element – Best Practice for Ship Operators is based largely on ISO/PAS 18152:2003, *A specification for the process assessment of human-system issues*, and *Alert! – The International Maritime Human Element Bulletin*. The information in this guide draws largely on the same sources. The cartoons are published courtesy of *Alert! – The International Maritime Human Element Bulletin*.

HCD.1 Understand the context of use

Human-centred design is based on a clear understanding of the situation in which the product will be used. This includes the goals that the users are expected to achieve, the users themselves, the tasks and the equipment, and the physical, social and organisational environments. The context of use should be analysed for potential human element issues.

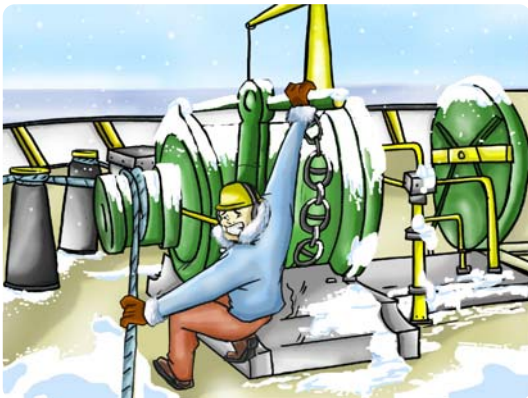
Will the product be used in one situation, or several?

Consider the range of likely contexts to help you ensure it is fit for purpose everywhere it will be used. These could be very different. Describe what goals are to be achieved in each situation.

What tasks or activities will the product be used to perform or support?

Consider why the product will be used to help you ensure that it does what the users and the company require of it.

Describe the individual tasks in the work and any required ordering, the demands placed on the user by the task, the potential sources of harm and how any risks are managed.



Who will be using the product?

Identify and consider the characteristics of each group of users., for example their jobs, role, responsibilities, authority, experience, age, size, weight, strength, language, cultural background, competence and motivation.

What else will the product be used with?

Consider other products that will be used nearby or at the same time. This will help you to avoid conflicts, or identify efficiency savings from co-ordinating them.

Describe the other work that users will be doing at the same time as using the product.

Other products includes personal protective equipment that users may be wearing, communication devices and any fixed equipment. It also includes any software.



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What will be the operating environment?

Consider the location and ambient conditions to help you ensure that the product will be suitable for the physical environment, such as the lighting, noise levels, vibration, temperature, hazards, working or living space; and the organisational environment, such as style of management, safety climate, response to authority and commercial pressures.

If it is not suitable, users may end up developing unofficial workarounds or shortcuts.



Consider whether occasional extreme conditions are likely to be encountered, which the product will need to be able to withstand.

Who else should know about these issues?

Consider to whom you should present your findings so far, so that any implications for the development or use of the product can be accounted for. It is better to raise such issues early on, so that any changes to the project or product, or to others that it will interact with, can be negotiated and implemented in a timely manner – and it is usually cheaper and easier to do this early on than near the end, or once the product is in use.

Having a team from across the company with collective responsibility for the product being successful will help, as improvement decisions may involve several departments. A multi-disciplinary team such as this does not have to be large, but it should be sufficiently diverse to make appropriate trade-off decisions during development – remember that changes may be necessary to other procedures, training, manuals etc.



How should change be monitored?

The context of use will change with time as the business, regulation, and recruitment change. This will eventually have an effect on the safe and effective operation use of the product. The company must monitor any changes, re-evaluate the resulting risks and make changes to the product or context as necessary.

HCD.2 Specify user requirements

The users of a product have needs, wants, constraints and desires that need to be captured. Analysis of the context of use reveals constraints and opportunities. Human strengths, weaknesses and limitations can be identified by the application of ergonomics. All of these requirements and human element issues must be analysed and reconciled with functional, performance and other product requirements. A definitive statement of user requirements with clear criteria for evaluation should be produced.

What behaviour and performance do you expect the product to give the user?

Consider the tasks that both the users and your company will expect it to carry out or to support, and the situations in which it will be used. Use these as a reference for the overall development and evaluation of the product.

If there is any intention to exclude some people from using the product, specify this. For example, you might intend that it will only be used by masters on your ships, or that it will only be used by people who have attended a particular training course. This will help you define what the product must provide, and what it does not need to provide.

Are users and designers working in collaboration to generate the requirements?

The closer the users and the designers work together, the more effective the user involvement will be. Involving users also makes them more likely to accept and commit to the product once it's in use.

The process should be interactive, and may be iterative to narrow down the user requirements and development specification progressively over time.

Remember that sometimes the requirements will constantly change, so defining them and responding may be an ongoing process.



Have you analysed the user requirements?

Productivity, safety and satisfaction apply both to individuals as users and the company as a user. Priorities, costs and benefits, 'showstoppers' and feasibility should be identified, evaluated and where necessary traded-off to ensure the best fit to both the end users' requirements and the company's needs (for example financial considerations or compliance with regulations).

Taking a long-term view will show the costs of failures and the benefits of usability throughout the life of the product.

Consider whether the users are likely to make assumptions about the product – if so, this may present problems, or you might be able to use this to advantage.

Document the user requirements so you can use them in design (HCD.3) and check whether they have been met later (during HCD.4).

Could using this product introduce any new risks?

Consider whether potential risks might be introduced, or whether existing risks or hazards might be increased, especially by use of a new product. These might include adverse effects to human health, safety or performance, or to the overall ship.

Information on this might be available from similar products that have already been introduced elsewhere in your company, or in other companies. Consider whether any of these risks can be 'designed out' at this early stage, either to remove the possibility of error or to reduce the likelihood or severity of escalation.



What criteria will let you evaluate the product in use?

These should be measurable, so that the performance of the product within its actual working environment can be assessed.

Any emerging problems can then be flagged up and dealt with early on, in a continuous process.

Who else should know about these issues?

Consider which project stakeholders you should present these issues to, so that any implications for the development or operation of the product can be accounted for.

You may need to involve people from a range of different disciplines or departments, for example to report any assumptions or constraints that have arisen so far and that may have implications elsewhere, or where the solution may be found elsewhere.

More human element data?

Analysis of the user needs may identify the need for more information about people, ergonomics, regulatory requirements etc. in order to make a decision. These data may already be available in standards, regulation, guide or the information that the company collects for other purposes or new data may need to be collected from surveys, experts, focus groups or trials with prototypes.



HCD.3 Produce development solutions

The focus of design must be to help the intended user to do their job correctly in the intended context of use. This requires an understanding of the user requirements and appropriate use of information about how to address human element issues (from regulation, guides, standards) and use of this knowledge when making compromises or trade-offs with other factors. Direct or indirect user feedback should be used to choose between the possible options as appropriate.

Is each required function allocated to the part of the system which is best placed to perform it?

Consider whether the functions (purposes or features of the product) could, and should, be carried out by seafarers on the ships, company staff ashore, or automation.

This decision should not be based solely on what the technology can or cannot do easily, with people left to deal with the rest however they can. Nor should it be based just on the way things have traditionally been done in the past.

Take a wider view of what would really be most appropriate for the overall safety and efficiency of ship operation.

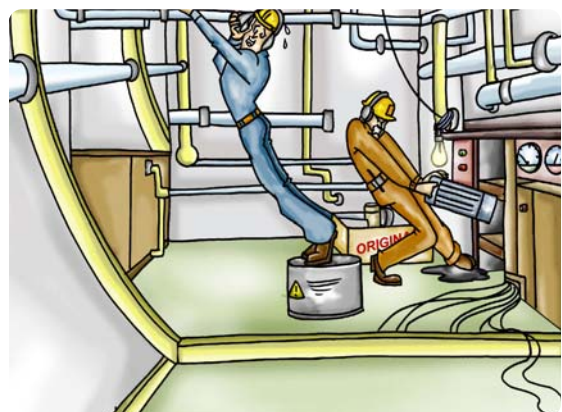


Have you described how the product will be used?

This should cover the aspects of the product that relate to how people will interact with it, and how it will interact with people.

This description includes the other work and responsibilities of the user when they are expected to use the product.

This description of the intended context of use is the basis of training and evaluation.



Have you tried it out with users?

Because humans and their interaction with products is hard to predict human centred development usually includes one or more trials with users. These may employ a detailed prototype or simulation of

some sort, or simply be a quick, rough mock-up to illustrate the overall scenario. Trials may be carried out to generate more human element data to refine the design or to get user involvement in selection between alternatives.

The trial should take into account the user requirements, the context of use, the proposed allocation of functions and the restrictions on development options.

Do your development solutions take the full range of human element issues into account?

Several development solutions may be produced at this stage. Consider the user requirements that you have previously identified, the context of use for the product, and the human element data that you have collected. Sometimes it may be necessary to collect additional information directly from users through interviews, demonstrations or surveys.

Other people may need to be involved in developing the solutions, such as trainers, technical writers or procedure developers.

Have evaluations of the product led to the development and safety features being revised?

Feedback from evaluations should be used to ensure the product specification effectively incorporates the human element considerations that you have identified.

Although it is always preferable to design out a problem engineering or business constraints may make this impossible. However, the human element requirements related to the product might not necessarily be met by altering the product itself, but perhaps by making changes elsewhere, for example to the staffing, jobs, roles or documentation.

The development process must include sufficient flexibility in the costings, schedule and contract to make changes based on feedback or other human element input.



HCD.4 Conduct evaluation of use

Feedback on the aspects of the product that relate to its use or its users must be collected and used. This allows conclusions to be drawn on a/ how to revise the design and b/ whether the product will prove to be adequate for its purpose and satisfactory to its users. Much of this information can only be reliably gathered by involving the users themselves.

Have you planned the evaluation?

Consider what information you will need to find out, and how you can test the product with real users, or people who can represent them if this is an appropriate alternative.

Be clear about which user requirements and risks are being assessed (based on your findings in HCD.2), and how you will assess whether they have been met. For example, you may use surveys, interviews, anonymous feedback forms or observation of use.

Remember to consider not only the effects on this product, but also the effects of use on other products or parts of the system, such as equipment or staffing.

Allow time at the end to weigh up the options, reflect on the decisions, and present the results to all involved stakeholders for their input and decisions.



Under what conditions will the system be tested?



The evaluation needs to be as realistic as possible to give meaningful data. Remember that the product might be used in a range of contexts of use, so several variations of the test may be needed to be sure that it will be adequate in all of them.

Real-life trials or field studies will give the highest fidelity and credibility, but remember that for some products or in some circumstances, trial-and-error could expose your crews or ships to unacceptable risks.

Is the system fit for evaluation?

Consider whether the product is ready to be tested and whether the relevant feedback can be gathered.

Remember that other related products or materials, such as documentation and user training, might need to be available for evaluation as well.

Have you carried out the evaluation according to the original plan?

This will ensure that the evaluation provides all the information which you set out to find, to allow you to assess whether the test was adequate and if the user and operational objectives have been met. Resulting decisions can then take proper account of the relevant human element issues.

If external influences mean the plan has to change, it is important to ensure that the new or revised plan still provides the necessary information, to ensure that the user requirements which were identified in HCD.2 will be met.

Remember that testing can show up issues or risks that could not be foreseen, or that are difficult to specify explicitly beforehand.

Have the results of the evaluation been acted on?

Analysis may be required to make sense of the findings, and to draw out the full value. The product or its requirements may need to be revised.

Different parts of the company may have to be involved in making all the necessary changes, for example to training, manuals or through-life maintenance associated with the product.

Allow time before the final deadline so that required changes can be made without producing delays. Otherwise in the face of severe time pressure, problems may be ignored now – but they will only recur in future, in real use, when failure could be far more costly.



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