Simple Guide to Human Factors Integration

Generic Guidance

If human performance is important to your business, Human Factors Integration (HFI) is the process of applying human factors.

HFI is simply a structured way of making sure human factors (typically end-users) have been considered throughout the project lifecycle.

If you are designing something that is particularly complex, hazardous or prone to error, managing HF as a specific activity throughout the project lifecycle will save you time and money in the long run.

This is by no means a comprehensive or exhaustive statement of Human Factors Integration, and if you are designing a complex system, further advice should be sought. But as a simple starter however, this document will provide you with an indication of the sort of Human Factors activities that that may be undertaken during a generic systems development or procurement life-cycle.

The following documents are also useful free sources of information.

Human factors integration: Implementation in the onshore and offshore industries. Prepared by BAE Systems Defence Consultancy for the Health and Safety Executive 2002
http://www.hse.gov.uk/research/

Human Factors Engineering Program Review Model. NUREG-0711, Rev. 2:
http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0711/

ONR Guidance on Human Factors
http://www.hse.gov.uk/nuclear/operational/tech_asst_guides/

HSE Guidance on Human Factors
http://www.hse.gov.uk/humanfactors/index.htm

Defence HFI: MAP-01-010 HFI Management Guide
http://www.hfidtc.com

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Concept and Requirements Phase

A new project starts for a reason. Something needs to be improved upon. In the very early stages of any project the focus of Human Factors is to identify and detail the existing issues. The emphasis will be on characterising the environment, end-users, the functions they need to carry out and the processes and tools they use. This is done as a baseline (current performance) and may be predicted (the future or goal performance). Human factors output in this early stage will provide the project with joined up thinking about what currently happens and what will happen in the future, who will be affected by the change and importantly, a rationale as to what needs to change and why (from a system / human performance perspective).

User Characterisation

A target Audience Description (TAD) will identify all the people affected by the project and detail the population anthropometry, skills, competencies and training (as applicable) as a record of 'who' the designers are designing for. This can be an important base document in the development of requirements, design and Training Needs.

Task Analysis / Operations Analysis

Managers and employees often think they know what it is they do and how the operations work. They think they have provided the designers with a good description of what they do and what they want to do in the future. In most cases they don't, and they haven't. Many projects fail or end up costing more because this is done poorly, leading to poor requirements capture. People often forget that the designers and software engineers are not likely to be experts in the very specific thing they are being asked to develop, and during the design process, the experts are too busy doing their jobs to support the project. The net result is that the system is often not designed for the end-users.
A **Baseline Task Analysis** is a document that details *what currently happens*, when it happens, where it happens, what tools are used, who is involved etc so that everybody, including the designers have a thorough and shared understanding of what currently happens.
A **Predictive Task Analysis** is a document that details the aspiration for *what will happen*, and how, so the designers have a thorough understanding of the detailed project goals.

Concept of Operations (CONOPS) or Operational Concept

The Operational Concept or Concept of Operations is the leadership vision of what the organisation is moving toward. What the new capability is and how it will function. It is not normally the task of the HF practitioner to develop this document but if the task analysis has been carried out at this stage it can be an important contribution. Like the task analysis, the Operational Concept can be a very important document in the development of a shared understanding or a shared goal that everyone is moving toward.

Requirements Development / Capture

The development of clear requirements is essential as they often form the basis of the contract. Human Factors practitioners will focus on the development of User Performance Requirements and HF specific System Requirements and Safety Requirement, as well as process requirements that will ensure the delivery of better, safer, viable human performance. The development of Safety Requirements may require Human Failures Assessment, whereupon Human Error Identification and Quantification is undertaken in support of the development of the safest designs.

HFI Management

Around this time, if not before the HF practitioner should be developing the HFIP, establishing an issues and assumptions database whilst integrating with the other systems and project engineers.

Design and Assessment Phase

If there are a number of different ideas or concepts about how you might resolve your problem there will often be a phase of design assessment where you aim to determine which of the options might be best. A system may perform well technically, but my fail dismally in the hands of an end-user. During this phase, a Human Factors engineer should be busy helping *designers* develop, deliver and demonstrate the potential solutions, and *buyers* to determine which solution makes their business function most efficiently and effectively.

Environmental Specification

Although the Environmental Specification my be required and developed during the concept phase to flesh out the HF requirements, it really needs to be completed and ready for use during the assessment phase. Going into the detailed design phase, the Environmental Specification is the document that details the physical environment in which people and systems will operate. As rule, it must at least specify issues such as workspace requirements, lighting (internal, external and task specific), acoustics, HVAC, finish, safety and DDA for example that may influence procurement requirements.

Interface Optimisation

Where larger, complex or bespoke interfaces are being developed, consistency may be important to improve operability and reduce error. A style guide can be developed to govern the development of a system interface by specifying such issues as the design of the control interface including how information will be presented, control interaction styles and colour schemes, rules of behaviour, icon sets and the use of input devices.

Issue investigation and user trials

During this phase it will be necessary to gather a much more detailed understanding of any new capability and how it will be used by the end-users. The majority of the HF domains will be considered here. Although trials and analysis will typically determine what works and what doesn't work with different designs, focussing on issues such as:

- Situation Awareness
- Workload
- Human Error
- The working environment
- Operator postures and workspaces
- Usability / Operability evaluation

HFI Management

Around this time the HF practitioner should be working closely with the designers, either in assisting with the design, or in an assurance role ensuring HF is being duly applied during the design process.

An issues and assumptions list can be used as the main document that documents the ongoing HF supporting tasks.

The HF practitioner can either lead or strongly support Hazard Identification and Risk Assessment, whilst also supporting other systems engineering functions such as Reliability and Maintainability, Requirements Capture and Training and Handover Planning.

Construction Phase

Unless integrated with the CDM (Construction Design and Management) function, the HF practitioner will typically have little concern with the actual construction of any physical systems other than the continued assessment as necessary or supporting any ongoing changes. With the detailed design closed out and subject to little further change, it is prudent to capture the existing information and look ahead to the future requirements of the project. This will typically entail the development of Test Specifications, Operational Procedures and consideration of Training design, development and materials.

Design Support

During construction it is likely that issues will emerge and last minute design changes or compromises will have to be made. The HF practitioner will assess the impact on the design in terms of Human Factors and human performance implications and make recommendations as to the acceptability of the design change.

Human Factors and Safety Assurance

In an assurance capacity, the HF practitioner will be ensuring that the project contractors and/or subcontractors are applying due consideration to HF issues and are delivering the correct outputs. They will also be facilitating and furnishing sub-contractors with information and access to end-user representation as required.

Operational Procedures

Where new equipment or processes are brought into operation, if people carry on doing what they did before the whole exercise may be a waste of time. The organisation must adapt to the new systems being introduced. Once the design has been fixed, the operational procedures can be developed as a result of ongoing testing. They should define precisely how the new systems are to be used within the new operational context. Procedures must also be developed defining how the new systems should be operated during degraded or emergency scenarios.

Training Needs Analysis (TNA)

The training needs analysis is a formal way of determining what the operators currently know, what they need to know in the future (to work with the new systems) and how they will be trained. The document will flow down from the Target Audience Description and Task Analysis work (baseline and predictive). Once the TNA is mature, it can be used to guide the development of training courses and materials.

Training Materials Development

Once the design has been fixed and the TNA is underway, attention can be turned to the development of training materials and training courses. In many cases the delivery of training will need to be carefully scheduled to ensure that it coincides with delivery and handover of capability. Too soon risks skill-fade. Too late is just too late!

For the introduction of larger systems, consideration of training and the design of training facilities and simulators would have occurred significantly earlier in the project lifecycle. Given their understanding of the tasks and operations derived from the task analysis, HF practitioners are often well placed to assess the quality of Operations and Maintenance Manuals delivered to or by the project.

Develop Final Test Specifications

During the requirements capture phase, baseline Factory and Site Acceptance test procedures should have been developed. These will need to be finalised in preparation for the Testing and Commissioning Phase.

Testing and Commissioning

HF can support the testing and acceptance of the systems being introduced, typically following acceptance test plans developed from the requirements documentation. Testing may be supported through the conduct of trials, to demonstrate the operability and performance of the system, specifically in degraded and emergency modes. HF practitioners can ensure that trials are designed properly so you get the information you need and the opportunity to capture good data isn't wasted. Change management plans, Training and operation and maintenance materials will be developed in support of Implementation and Handover.

Factory Acceptance Test Specification (FATS)

HF practitioners can develop the test specifications relevant to Factory Acceptance Testing.

Site Acceptance Test Specification (SATS)

HF practitioners can develop the test specifications relevant to Site Acceptance Testing.

Operational Trials

Complex systems may require that operational trials are conducted to ensure the system is performing against the requirements and specifications.

Those HF practitioners with formal HF training (usually inclusive of experimental methods, trials design and statistical analysis), will be able to develop a scientifically valid trials design to ascertain both human and system performance.

Many people waste valuable testing time taking the wrong data, or data that turns out to be difficult to analyse. By doing it properly, a HF engineer can capture the right qualitative (personal opinions) and quantitative (numerical evidence) data that will help you determine whether something is working or not.

It is important to distinguish between Measures Of Performance and Measures Of Effectiveness. That expensive new computer you install may *perform* brilliantly as a desk-top, but may not make any difference to the *effectiveness* of your staff. The question is why?

Operational Procedures

Develop final Operational Procedures and materials in preparation for handover and acceptance (see previous—Construction Phase.

Training Materials

Develop final training materials in preparation for handover and acceptance (see previous—Construction Phase).

HFI Management

During the Testing and Commissioning Phase, HFI management will focus on the testing, managing and closing out of issues, and preparing for handover.

Implementation and Handover Phase

HF personnel can support the change management and training effort. Carry out post occupancy testing and continued systems assessment to confirm system performance.

Change Management

HF practitioners can assist in the management of the transition from one system to the next, whether it be a 'big bang' implementation or a gradual evolution. People respond differently to change, some embrace it and others simply hate it. A good Change Management strategy won't solve all your problems but you certainly need one. Having participated in the training needs and operational analysis, a HF practitioner is often well placed to advise on how best to make the change.

Operational Analysis

Once the system has been implemented and things have settled down, further operational analysis can be carried out to measure the success of the project. Was it all worth while? Have the previous problems been resolved? Has performance increased in line with expectation?

HFI Management

During the Implementation and Handover Phase, HFI management will focus on ensuring all necessary issues are closed out, and the documentation is complete and handed over.

The final HF report will be produced along with any 'Lessons Learned' documentation as necessary.

Decommissioning Phase

Where decommissioning carries specific issues or risks, the practice of decommissioning a system should have been considered throughout it's design and development. HF practitioners can work with projects to develop safe and efficient methods in the decommissioning of hazardous systems. Often decommissioning is carried out as a new project, which would entail many of the activities carried out above.

Design for Decommissioning

If the decommissioning of a facility, system or capability is hazardous undertaking, human factors analysis it should be considered throughout the project lifecycle as a specific activity.

Decommissioning Projects

Many systems are designed without a good understanding of how they will be decommissioned. Even if they were, when decommissioning is necessary, it often occurs as a specific project. It will be necessary to consider such issues as remote handling, exposure [time] to hazardous substances, operator time pressure and stress. The vast majority of the HFI procedures discussed with respect to previous lifecycle phases will apply, specifically:

- Task Analysis
- Hazard Identification
- Risk Analysis
- Operations Design and Optimisation