# The Application of the ICF and Related Resources to Improve Universal Design Guidance Standards

## Guidance on integrating optimal terminology and classifications to improve a new revision of Guide 71:2001

*Prepared for*

Centre for Excellence in Universal Design

National Disability Authority

25 Clyde Road

**30th October 2012**

The National Disability Authority (NDA) has funded this project. The project was managed by the Centre for Excellence in Universal Design at the NDA. Responsibility for the project (including any errors or omissions) remains with the Work Research Centre. The views and opinions contained in the report are those of the authors and do not necessarily reflect the views or opinions of the National Disability Authority (NDA)

**Table of Contents**

# 1. The Application of the ICF and Related Resources to Improve Universal Design Guidance Standards

## 1.1 Overview of the Project and Resulting Guidance

Accurate terminology based on internationally agreed language is fundamental to design especially where human involvement is expected, in order to help ensure the optimum integration of requirements and characteristics into a design. This is required across all human, technological, economic, environmental and organisational factors that affect the behaviour, activities and well-being of people in work, domestic and leisure contexts. (ISO 26800:2011)[1]

The international review upon which this guidance document is based concluded that the application of the World Health Organisation International Classification of Functioning, Health and Disability (ICF) can result in a more precise, consistent and internationally recognised language and terminology to describe the design process.[2] The ICF can support a consistent approach in analysing key variables to identify and define aspects that need to be taken into account in designing for accessibility and usability. No other related resource can be considered sufficient to substitute for the ICF. The review recommended that the most appropriate approach to enhancing Universal Design guidance standards needs to involve a combination of the ICF and additional resources. Evidence to support this was found in a number of initiatives that have used the ICF and other relevant resources designed to document human abilities and their interaction with the environment.

Following on from the international review, this guidance document has been developed to provide a description of how best to use codes and terminology from the ICF and related resources in developing Universal Design guidance standards. The document includes a number of examples which demonstrate the approach. ISO/IEC Guide 71:2001, *Guidelines for standards developers to address the needs of older persons and persons with disabilities* is used as a key reference.[3]

a) It builds on a systematic review of international literature relating to the integration of ICF and related resources into non-medical systems and domains.
b) It explains the importance of the ICF as a basis for developing a consistent design terminology which is internationally recognised.
c) It provides guidance, rules and procedures that can serve as a basis for a systematic approach to linking terminology, currently utilised in

international design guides, to relevant internationally accepted terms and classifications including the ICF.

d) The application of these rules is illustrated and discussed with regard to Guide 71:2001 terminology.
e) It describes how the ICF can be applied to three interacting design components, the Person, the Activity and the Environment in the development of design guidance standards.
f) Examples of the how ICF terms and concepts can be applied to the design of products, buildings, services and information and communications technology (ICT) are provided.

## 1.2 International background

This document is based on an international review of the application of the ICF and a number of related resources to characterising human activity and person-environment interactions in a diverse range of non-medical systems and domains.

The international review examined over 155 sources and found that, since 2008, there has been a marked shift towards the application of the ICF in a wide range of non-medical systems and domains, including design processes. The general consensus that emerged from these initiatives was that although ICF needs to be augmented in a number of areas it adds significant value in those domains in which it has been applied. [4]

## 1.3 Positive characteristics of the ICF

In its introductory text about the ICF, the WHO clearly specifies Universal Design amongst the intended ICF Applications: [5]

"*… environmental assessment for universal design, implementation of mandated accessibility, identification of environmental facilitators and barriers, and changes to social policy*" p. 6

In Annex 8 of the ICF Manual there is an intention on the part of the WHO to:

"*…achieve recognition of the ICF by various national and International Communities, WHO has made every effort to ensure that it is user friendly and compatible with standardization processes such as those laid down by the International Organization for Standardization (ISO)*" p. 251.[6]

To date the ICF has been adopted in 191 countries and has a number of positive characteristics which make it a useful framework and classification system, particularly as a basis for characterising human function, when attempting to

analyse the dynamic interaction between a person and his or her environment. These include:

a) It systematically describes human functioning in all people and not merely disability;
b) It is applicable to all stages of the life span and equally relevant to congenital, developmental, or acquired differences in functioning including those that emerge as a result of ageing;
c) It can systematically document the interactive process, through which the environment (products, services, built environments and ICT) can impact, act as a facilitator or a barrier, to people's activities and participation performance;
d) The language of the ICF is neutral, unlike the terminology associated with many deficit-based classification systems;
e) It incorporates not merely biological aspects of a person but also the psychological and social elements;
f) It provides a unified and standard language and framework, which are consistent, clearly defined and unambiguous, and is available in the majority of the world's major languages;
g) It is congruent with the UN Convention on the Rights of Persons with Disabilities (UNCRPD) and its use is recommended in the WHO World Report on Disability.[7]

## 1.4 The application of the ICF to design

The international review examined a range of non-medical domains including the development of international data standards; inclusive education; employment; social security; sport; and tourism and identified that the ICF was being used at different levels of detail depending on the focus and scope of the area or topic in question. This section explains the different levels of detail at which the ICF can be applied, discusses how it can be used in the field of design, describes the ways in which the most relevant ICF codes to Universal Design can be identified and briefly introduces a set of rules that have been developed for linking terms and concepts to the most appropriate ICF codes.

### Levels of application of the ICF

At national and international levels the ICF can be used to inform data collection and disability policy development. For example, in the development of questions for national and international surveys, an area of particular concern to the United Nations Washington Group on Disability Statistics, the key distinctions of impairment, activity, participation and environment are crucial. [8] Thus, questions are designed to distinguish between body function and participation. The Measure of Activity and Participation (MAP), which has been integrated into the Health

Research Board (HRB) National Physical and Sensory Disability Database (NPSDD), has three sections each of which explores different aspects of disability, i.e. participation, activity and environment. [9] At this level of application the content is not always directly linked to specific codes but is aimed at eliciting responses which can distinguish between having an impairment and being restricted in participation.

At a more detailed level, the ICF can be used to inform specific initiatives or can be applied to individual health conditions in an intervention context. It has been used extensively to document the most important aspects of functioning, activity and participation, and environment to be addressed with regard to specific health conditions.[10] These applications require a precise mapping of terms and concepts to ICF codes. In this regard, the ICF can be applied at three classification levels, one, two and a detailed classification with definition levels depending on the level of detail required. These are described in more detail in Annex 1.

**Using the ICF in the field of design**

The ICF can be applied at a framework or conceptual level which addresses design as a mechanism for producing more enabling environments or as a way of reducing restrictions in participation without reference to specific codes. This is analogous to the national and international applications described above. At a more detailed level, the ICF can be used as a basis for generating more precise and internationally accepted terminology to describe design factors and personal attributes by linking to specific ICF codes. The latter application requires a standard set of procedures for linking terms and concepts to specific ICF codes.

The applications of the ICF in the field design, which were identified by the international review, tended to apply the ICF to link human characteristics to environmental attributes, although not all applications used a precise linking to individual ICF codes. Some examples are provided below.

a) The relationship between the ICF and the principles of UD;[11]
b) Linking ISO9999 on assistive technology to the ICF; [12]
c) Linking Guide 71 Human Abilities to ICF;[13]
d) Standardised user models for inclusive design;[14]
e) Representations of everyday activities;[15]
f) Describing person environment Interactions; [16]
g) Characterising person-object interfaces;[17]
h) Assessing motor and process skills (AMPS);[18]
i) The design of emergency services, architectural products, ICT applications, computer games; and household products.

**The development and application of ICF Core and Short Sets**

In order to make the application of the ICF more efficient and targeted, a number of *core sets* have been developed over the recent years which reduce the number of codes to between 30 and 70 for particular conditions or particular contexts e.g. the post-acute stroke rehabilitation core set or the vocational rehabilitation core set.[19] A process of developing core sets for specific conditions has been instigated by the WHO and a number of researchers. The methodology used to reduce the overall complexity of the framework utilises a combination of Delphi survey techniques, document analysis and expert focus group methodologies to reduce the 1500 codes of the ICF to a manageable number for a specific condition in a specific service context.

The ICF Research Branch has carried out extensive work in the development of ICF core sets. [20] The collaboration has developed a methodology for developing specific lists of core ICF elements that can be used by practitioners when responding to people with a range of impairments. The methodology to produce a core set includes empirical multicentre research, systematic literature reviews, qualitative studies and expert surveys. The findings of these activities are then presented to an International Consensus Conference which produces an initial version of a core set. This is then distributed to practitioners for field testing and validation.

In some organisations specific *short sets* of ICF codes, most relevant to the main purpose of the organisation, have been developed. For example, a large rehabilitation provider in Germany has developed a short list of ICF Codes which is used for assessment of needs, individual programme Planning and monitoring the progress of services users. The European Platform for Rehabilitation organised an ICF working group to assist its members to identify appropriate core sets, and develop short sets, for use in the identification of needs and the planning of services.[21] Recently a European project (ProMenPol) has produced an indicative short set for application in the field of mental health promotion. [22]

The international review, which forms the basis of this guidance, concluded that the development of a Universal Design short or core set would be a useful step in developing a consistent and international accepted set of terms and definitions for Universal Design guidance standards. This is discussed in more detail in Section 3.2.2.

**ICF Linking Rules**

A set of linking rules have been developed to assist in the mapping of terms and concepts to ICF codes. These rules have been used most frequently in clinical, educational and social security spheres. The rules provide a set of steps that can be applied in order to focus on the most appropriate ICF code to represent a specific term and concept. These rules have the potential to support the development of

internationally accepted definitions and terms, which are translated into a wide range of languages, in the field of design. This is an essential step in producing design guidance standards. The linking rules are described in Section 3.2 of this guide and a detailed specification is provided in Annex 2.

## 1.5 Areas where the ICF requires to be augmented

The majority of applications using the ICF indentified that it required enhancement or augmentation by additional and complementary tools or terminologies in a number of areas which are essential to the design of products, services, built environments and ICT applications with enhanced accessibility and usability.

a) **Personal Factors:** The ICF does not provide a taxonomy of personal factors, some of which are key human factors in Universal Design and design standards, such as stature, arm length, expectations, self-efficacy, and temperament.
b) **Human-task interactions:** The ICF does not provide a means of coding the processing requirements associated with specific tasks, such as the activity of lifting and carrying objects of different weights or assembling all essential operational components to carrying out the task.
c) **Environmental factors:** The ICF approach to coding the environment is largely descriptive. It specifies key environmental domains to be considered. It does not provide an analytic framework for specifying how a product or service can be designed to enable the user
d) **Body function, body structure and activity:** The most clearly elaborated domains of the ICF relate to body function, body structure and activity. Nevertheless, it has a number of discontinuities which require to be addressed, such as the way in which 'dexterity' is characterised.

## 1.6 Related resources for augmenting the ICF

While the ICF offers a comprehensive list of codes across its components of Body Functions and Structures, Activities and Participation and Environment, it is by no means complete. Some commentators contend that using ICF environmental factors as they currently stand represents a significant challenge.[23] Sandford and Bruce (2009) offer a detailed critique of the role of the ICF in articulating environmental concerns.[24] They especially highlight its exclusion of attributes of environmental constructs. There are a number of very useful related resources which can be considered for this purpose.

SNOMED-CT (Systematized Nomenclature of Medicine-Clinical Terms) is a comprehensive clinical terminology, originally created by the College of American Pathologists (CAP). [25] SNOMED-CT is a propriety resource whose use

is subject to terms of a commercial license. SNOMED-CT offers codes for many concepts across the domains of the ICF components. SNOMED-CT concepts are organised around concept groups which classify the concepts into taxonomic hierarchies. SNOMED-CT concepts include Body Structures, Environment or Geographical Location, Events, Activities, Observable Entities, Social Context and much more. It also offers the ability to add new concepts. It is an extremely powerful specification mechanism in its own right.

While the primary purpose of SNOMED-CT is to support the effective recording of clinical data with the aim of improving patient care, it provides many additional codes which can be used to augment the ICF. It can be a very useful resource for the provision of alternative codes for concepts which are not described by the ICF. For example, it offers a comprehensive list of parts of the hand not available in the ICF. It has codes for activities such as "shopping with a credit card" that the ICF lacks. It has an extensive range of environmental codes describing spaces of the physical environment, such as residential homes, office reception areas. SNOMED CT has been already been linked to the ICF under a recommendation of the US Consolidated Health Informatics (CHI) initiative.[26]

Other resources were also identified that could be used to augment the ICF especially in relation to the physical environment. *UniClass* is one such classification system which is of UK origin.[27] UniClass is a classification system for the construction industry. It has some very good classification codes, particularly for information elements of the built environment such as warning signs.

Another system, which offers richer content than UniClass, is the US *OmniClass* Construction Classification System (known as OmniClass™ or OCCS). This is extremely useful for describing many aspects of the physical environment. OCCS is a classification system for the construction industry. [28] OmniClass is useful for many applications including organizing library materials, product literature, and project information or providing a classification structure for electronic databases.

In contrast to SNOMED-CT, which operates under commercial license, *OmniClass* operates under open license. OmniClass consists of a number of tables. These cover, amongst others, constructs such as Spaces by Function, Products and Information. OmniClass offers strong representational features in environmental factors that are not well specified by either ICF or other related resources. These include a comprehensive listing of physical spaces such as residential, outdoor spaces and much more. It provides a major listing of products to do with the built environment especially everyday products under the heading of Residential Products and Equipment. OmniClass Table 49 (Properties) lists attributes of many environmental constructs not well covered by the ICF and is a major resource for describing the physical environment.

# 2: Terms and Definitions

This guide uses a combination of terms that are derived from ISO/IEC Guide 71:2001, the ICF and other related resources. This section discusses and describes the primary terms and concepts. Additional clarification of terminology is provided in Section 4 of this guide.

## 2.1 Human factors

These are the biological characteristics that can be validly applied to the specification, design, evaluation, operation and maintenance of products and systems, to enhance safety; and effective and satisfying use by individuals, groups and organizations.

## 2.2 Human abilities

Human abilities is the term used in Guide 71:2001 to refer to the needs and abilities of people in any particular age group including functional and cognitive limitations which can vary from comparatively minor impairment to more extreme forms.

## 2.3 Body function

Body function is the terms used in the ICF to refer to a physiological or psychological function of a body system.

## 2.4 Body structure

Body Structure is the term used in the ICF to refer to the anatomical parts of the body, such as organs, limbs and their components.

## 2.5 Impairment

This term refers to problems in body function or structure such as a significant deviation or loss which can be temporary due, for example, to injury, or permanent, slight or severe and can fluctuate over time, in particular, deterioration due to ageing.

## 2.6 Activity limitation

In the ICF, activity refers to the execution of a task or action by an individual. An activity limitation refers to any difficulty an individual may have in executing a task or actions.

## 2.7 Participation restriction

Participation in ICF terms is involvement in a life situation. Participation Restriction is any problem an individual may experience in involvement in life situations.

### 2.8 Capacity

The ICF refers to capacity as the extent of a person's ability to execute a task or an action based on the inherent or intrinsic attributes of the person him or herself without the assistance of another person, or assistance provided by an adapted or specially designed tool or vehicle, or any form of environmental modification.

### 2.9 Performance

Performance is defined by the ICF as the extent to which a person is able to execute a task or action in his or her current environment including all aspects of the physical, social and attitudinal world, assuming that he or she wishes to do so.

### 2.10 Disability

Disability is used by the ICF as an umbrella term for impairments, activity limitations and participation restrictions.

### 2.11 Accessibility

Accessibility is defined in *Ergonomics - General approach, principles and concepts* (ISO 26800:2011) as the extent to which products, systems, services, environments and facilities can be used by people from a population with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of use.

### 2.12 Universal design

Universal Design is the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialised design (Accessible Design is a subset of Universal Design).

### 2.13 Assistive technology

Assistive technology refers to any piece of equipment, product system, hardware, software or service that is used to increase, maintain or improve functional capabilities of individuals with disabilities. Assistive devices do not eliminate impairment but may lessen the difficulty an individual has in carrying out a task or activity in specific environments.

### 2.14 Environmental Factors

Environmental factors, in the ICF, refers to the physical, social and attitudinal environment in which people live and conduct their lives (Environmental factors

include Products and technology, Natural Environment and human made changes to the Environment, Support and relationships, Attitudes, and Services systems and policies).

### 2.15 Factors to be considered in the design process

Guide 71:2001 specifies design factors as factors to consider in making products and services accessible. They are the attributes of products, services and the built environment that assist or hinder older persons and persons with disabilities.

### 2.16 Alternative format

An alternative format, according to Guide 71:2001, is a different presentation which may make products and services accessible by the use of another modality or sensory ability.

### 2.17 User

The user is the person who interacts with a product, service or environment.

### 2.18 Usability

Usability is defined in ISO 9241-11 (1998) as the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use. Wider usability refers to design factors which expand the range of users with different abilities for a particular product, service or physical environment.

# 3. Linking the ICF and Related Resources to Universal Design Guidance Standards

## 3.1 The Dynamics of Universal Design

The conceptual approach adopted by this guide incorporates a primary aim of Guide 71:2001, which is to outline the relationship between the requirements in standards and the accessibility and usability of products and services. It utilises a combination of concepts derived from Guide 71:2001, the ICF and related resources.

It provides a framework for characterising the potential impact of Universal Design factors on the usability of products, services or the built environment in the development of design guidance standards. The dynamics of Universal Design are illustrated in Figure 1. The figure is derived from the ICF flowchart. A brief overview of the ICF is presented in Annex 1 for those who are not familiar with its domains, codes and qualifiers.

The left hand side of the figure presents the starting point for a disabling or enabling process. Problems in body function or structure, in the abilities of individuals or an aspect of their personal characteristics result in a reduction in capacity. Capacity is the extent of the ability to execute a task or an action based on a person's inherent or intrinsic attributes without the assistance or any form of environmental modification or support.

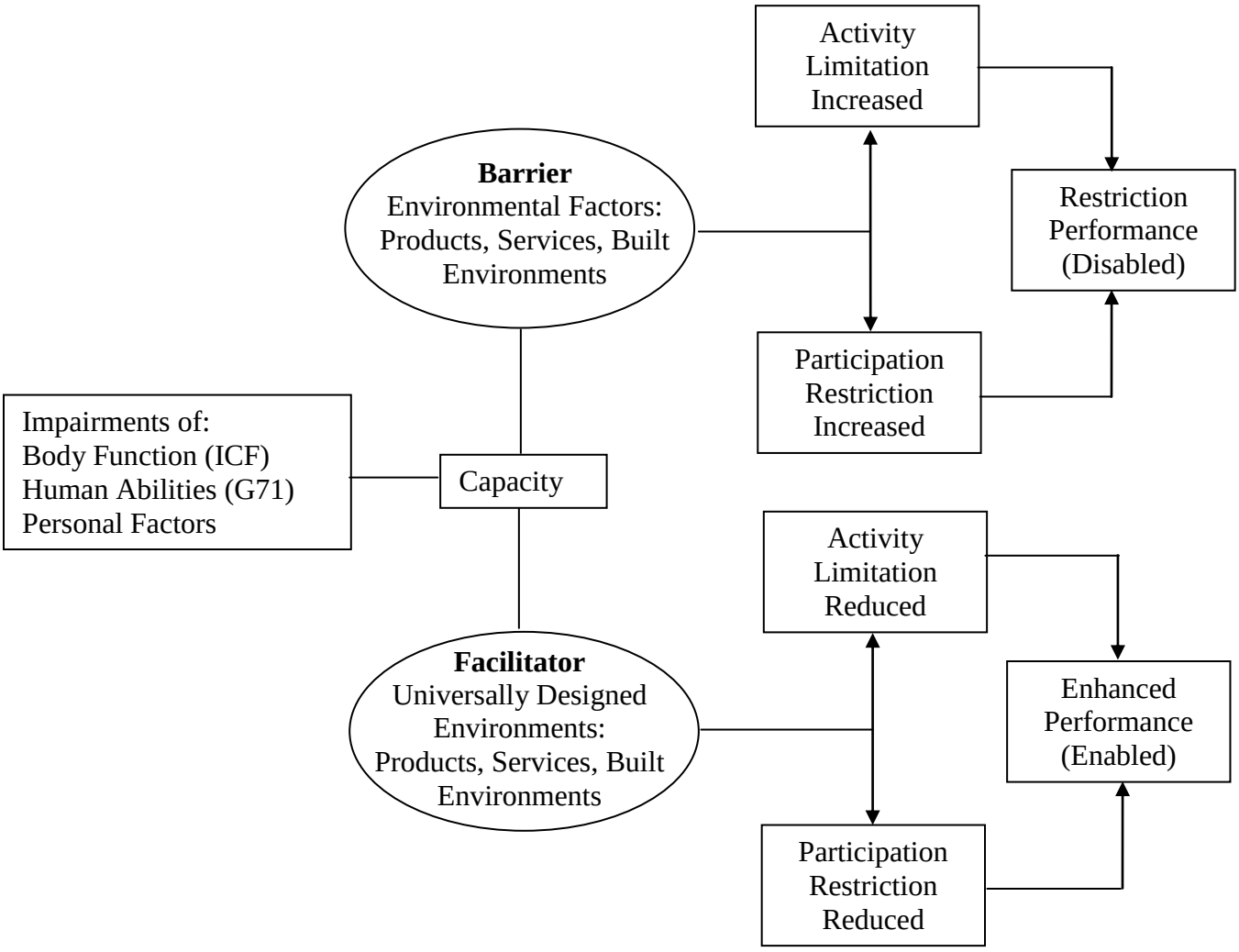
The environment is an intervening variable which can impact negatively or positively on the person's activity in terms of actually implementing the task or action or participation in a life situation.

The upper section of Figure 1 illustrates the negative or disabling impact of a non-modified environment or one which has not been designed on the basis principles of Universal Design. This results in activity limitations, difficulties in executing tasks or actions and/or participation restrictions in involvement in life situations. In other words, it creates a barrier to performance. This is measured in terms of a person's performance in actually implementing tasks or actions he or she wishes to in the context of the current environment.

The lower section of the figure illustrates how Universal Design and the application of the Guide 71:2001 facilitating factors to the design of products, services or buildings can positively impact on a person in terms of reducing

activity limitations and/or participation restrictions and enabling enhanced performance of tasks and actions.

**Figure 1: The dynamics of universal design in enhancing the execution of tasks or actions**




**Person, Activity and Environment:**

Taking account of the interaction of the three components Person, Activity and the Environment (PAE) is key to understanding, representing and communicating design concepts relating to products, services or the built environment. By addressing each of these in relation to design, the impact on accessibility and usability can be specified in a detailed and consistent manner.

- **Activity** refers to what a person must do to use a product, service or built environment.

The activity that is involved in using products, services or built environments can be specified by applying the ICF Activity and Participation – 'd' codes.

- **Person** refers to the mental and physical functions and personal characteristics that may impact on carrying out an activity.

  It is possible to define the personal attributes that may impinge on a person's capacity to engage in the activities using the Body Function – 'b' codes and the Body Structure – 's' codes. It may also be important to consider Personal Factors that are relevant such as age, gender or body size. These are not coded by the ICF and should be specified using other sources.

- **Environment** refers to the design factors, including physical, social and attitudinal factors, which may act as facilitators or barriers to a person's performance in using products, services or the built environment.

  The ICF provides codes for Environmental Factors – 'e' codes, which can be used to indicate whether a design factor is likely to act as a barrier to, or a facilitator of, accessibility and wider usability. More detailed environmental concepts may require the ICF codes to be augmented using other sources.

A key attribute of the ICF is that it can provide a precise specification of these three concepts.

Two examples can help to elaborate the application of the ICF to generate consistent terminology. Both examples address the impact of the Guide 71:2001 design factor Surface Finish (8.18) on the activities of *walking* (d450) and *moving around in different locations* (d460). Annex 1 provides a more detailed explanation of the ICF domains, codes and qualifiers.

**Example A: The impact of a slippery floor on a person with no impairment**

Table 1 presents the way in which ICF codes and qualifiers can be used to represent each of the design components Person, Activity and Environment. The person in this example normally does not experience difficulties in walking or moving around. However, she is in a building with a slippery floor surface which has recently been washed.

Walking and moving around are represented by 'd' codes indicating that they relate to *Activity* or *Participation*. Each activity or participation numeric code can be associated with two qualifiers after a decimal point, the first of which indicates the extent to which the person's *performance* of activities are limited in their current environment and the second which indicates his or her *capacity* based on inherent or intrinsic attributes in the absence of environmental factors. The impact of the slippery floor is specified in row four of the table. In this case *performance* in walking (d450.20) and moving around in different locations (d460.20) is moderately limited as indicated by the first qualifier XXX**.2.** The fact that

normally her capacity would not be limited is indicated by the second qualifier XXX.2**0**.

The attributes of the person are described using the ICF *Body Function* codes. In the current example, the person has no reduction in functioning relating to joint mobility. This is represented using the 'b' codes of the ICF and qualifier indicating no impairment of functioning (b710.**0**).

**Table 1: Documenting the impact of Guide 71:2001 Design Factor – Surface Finish (8.18) using the ICF (Person with no limitations)**

| **Walking in a Public Building** | | |
|---|---|---|
| **Activity** | | • Walking (d450)<br>• Moving around in different locations (d460) |
| **Person** | Has no **Impairment** of joint mobility | • Joint mobility (b710.0) |
| | No limitation in **Capacity** to walk and move around (in a standard environment) | • Walking (d450._0)<br>• Moving around in different locations (d460._0) |
| **Environment** | A building with a slippery surface can be a moderate **Environmental Barrier** | • Design, construction and building products and technology of buildings for public use (e150.2) |
| **Impact** | A moderate limitation in the **Performance** of walking and moving around | • Walking (d450.20)<br>• Moving around in different locations (d460.20) |
| | | |
| **Environment** | A building using a non-slippery surface - Guide 71 [Surface Finish 8.18] can be a complete **Environmental Facilitator** | • Design, construction and building products and technology of buildings for public use (e150+4) |
| **Impact** | **Performance** is completely facilitated | • Walking (d450.00)<br>• Moving around in different locations (d4601.00) |

The building has a slippery floor surface which acts as an *environmental barrier* to walking and moving around even though the person has no reduction of physical function. This is represented using the 'e' codes of the ICF and a qualifier specifying the extent to which the environment is a barrier (e150.**2**), based on the

scale of 0 to 4 where 0 represents no barrier and 4 indicates a complete barrier, indicating a moderate barrier.

The lower section of the table indicates that the application of the Guide 71:2001 design factor (Non- Slippery Surface Finish) is an e*nvironmental facilitator* which completely facilitates the person's performance in walking and moving around. This is indicated by using the qualifier **+4** (e150+4), based on a scale of 0 to 4 where 0 represents no facilitator and 4 indicates a complete facilitator.

The impact of the facilitator on performance is represented by the codes and qualifiers, Walking (d450.**00**) and Moving around in different locations (d4601.**00**).

**Example B: The impact of a slippery floor on a person with a moderate impairment of joint mobility**

The second example, presented in Table 2, illustrates the same situation but for a person with a moderate impairment of joint mobility (b710.**2**) as a result of impairment in his or her lower body. This is represented using the 's' codes of the ICF which specify the Body Structures which are associated with reduced body function (s750.**2**).

The consequences of this are mild limitations in the person's capacity to walk (d450.**_1**) and move around (d460.**_1**). However, a building in which the floor surface is particularly slippery can represent a substantial barrier (e150.**3**) and as a result the person can experience a severe difficulty in performance of walking (d450.**3**1) and indoor mobility (d460.**3**1).

Conversely, the same person may have no restriction in indoor mobility performance in a building that has been universally designed and takes into consideration of the factors specified in Guide 71:2001 including Surface finish (8.18). This is presented in the lower section of the table. In this case the non-slippery floor is a complete environmental facilitator (e150**+4**) and the person's performance is enhanced despite the mild capacity limitation he or she would experience in a standard environment (d450.**0**1 and d460.**0**1).

These examples serve as a good illustration of how the ICF emphasises that the components of Person Activity and Environment are interacting variables of a dynamic eco-system. This interaction is also emphasised in other International Standards for example the Ergonomics Standard (ISO 26800:2011).

**Table 2: Documenting the impact of Guide 71:2001 Design Factor - Surface Finish (8.18) using the ICF (Person with moderate limitations)**

| **Walking in a Public Building** | | |
|---|---|---|
| **Activity** | | • Walking (d450)<br>• Moving around in different locations (d460) |
| **Person** | Has a moderate **Impairment** of joint mobility | • Joint mobility (b710.2)<br>• Structure of the lower extremity (s750.2) |
| | A mild limitation in **Capacity** to walk and moving around (in a standard environment) | • Walking (d450._1)<br>• Moving around in different locations (d460._1) |
| **Environment** | A building with a slippery surface can be a substantial **Environmental Barrier** | • Design, construction and building products and technology of buildings for public use (e150.3) |
| **Impact** | A severe limitation in the **Performance** of walking and moving around | • Walking (d450.31)<br>• Moving around in different locations (d460.31) |
| | | |
| **Environment** | A building using a non-slippery surface Guide 71 [Surface Finish 8.18] can be a complete **Environmental Facilitator** | • Design, construction and building products and technology of buildings for public use (e150+4) |
| **Impact** | **Performance** is completely facilitated | • Walking (d450.01)<br>• Moving around in different locations (d4601.01) |

## 3.2 Rules for Linking Universal Design Guidance Standards

A prerequisite for the unambiguous and systematic application of the conceptual framework described above to Guide 71:2001 and associated technical reports is the explicit mapping of terminology between the ICF and other relevant resources. This requires an agreed set of principles and rules for linking and mapping terms and concepts defined by these systems to classifications and terms in Universal Design guidance standards.

### 3.2.1 ICF Linking Rules

A set of linking rules was developed by Cieza et al (2005).[29] These can be used as the basis for identifying appropriate equivalences between current design terms and the codes and definitions in the ICF. A detailed description of the Cieza rules and additional rules generated as a result of the international literature review are presented in Annex 2. A subset of the rules is briefly described below.

- A prerequisite for accurate and appropriate linking is a good working knowledge of the ICF.
- A term and its related concept should be linked to the most precise ICF category.
- Where no corresponding ICF code is found, do not use the so-called "other specified" ICF categories but document the additional information.
- The original domain term and the matching ICF code(s) should be recorded together in the resultant documentation produced by the mapping process.

  The terms recorded should include:

  <Source Term > Source Reference & (ICF Term) ICF-Code:

  For example, <Balance > 9.2.5 & (Vestibular Functions) b235:

- When the ICF cannot provide an appropriate code, alternates from other sources should be sought.

### 3.2.2 The process of linking to the ICF

When attempting to code concepts by selecting terminology from the ICF, there are two broad ways to proceed. One involves a conceptual translation and the other involves using the ICF online browser.[30] It is advisable to carry out a conceptual translation of the items to ICF codes initially and then to check and validate the links using the browser.

### Conceptual Translation

The conceptual approach to mapping is shown to be the most effective. This is due to the superior natural language processing power of the human and the comprehensive search of the classification manual that can highlight a greater number of possible matches.

The success of this approach has to be qualified as having some limitations since the resultant matches may be flawed in many cases. For example, it may be difficult to match composite terms. There may be no one-to-one correspondence. Some of the matches can be vague. Many terms can map onto the same ICF code.

The sense of the item being translated to these codes can be compromised by vague terms.

In some cases, the words can only be matched at a very high abstract level. For example, '*Creativity*' only matches under the heading of the more abstract '*Thinking'* codes.

The conceptual translation of codes may require extending the meaning of a term to make a match. For example, consider the concept of calmness or being composed. This could be linked with the code *b1263 Psychic Stability (mental functions that produce a personal disposition that is even tempered, calm and composed, as contrasted to being irritable, worried erratic and moody)*, but this is extending the meaning very substantially.

Clearly, the process of mapping is a very complex process. There are many different senses in which the words can be interpreted. There are possible matches with both synonyms and antonyms.

In the final analysis, there is no substitute for a good knowledge of the ICF before embarking on a linking exercise.

**Using the ICF Browser as a Linking Mechanism**

The ICF Browser can be accessed through the WHO ICF webpage or by following the link http://apps.who.int/classifications/icfbrowser/. When you enter the Browser the four domains Body Functions, Body Structures, Activities and Participation and Environmental factors are displayed at the left of the page. A search box is displayed into which terms can be entered in order to search for terms and explore codes which correspond to the search term.

There are two main approaches to using the browser. These are:

- Entering the key phrase of an item into the ICF online browser;
- Entering the individual words of an item into the ICF online browser.

There are a number of points that need to be taken into account in order to achieve good results using the ICF Browser. Some of the key points are listed below.

- The ICF online browser basically uses string matching to search the classification. This means that if the phrase entered is not a sub-string of an entry in the ICF, then no results will be returned for that query.

- For the purposes of linking, 'stop' words, such as pronouns and prepositions, should not be considered since these add little to the semantic

interpretation of the item. For example, the item '*My childhood technology experiences'* should be stripped of the stop word *my*.

- The source term or word can also match with the antonym of a word or an equivalent synonym of the source word. For example, *comfort* doesn't produce a result but its antonym *discomfort* does. Further, the result can refer to a different sense of *discomfort* than the item intended. For example, *discomfort* in the sense of clinical pain rather than discomfort as a sense of unease about something.

- Many codes related to the same concept may be returned. A term occurring in the body of a text can be associated with numerous codes, many of which have opposing meanings. The opposite situation, namely too many items mapping onto the same code**,** may also be a concern.

- Some codes are sufficiently vague or have too many inclusions and consequently many diverse concepts are mapped onto them. Codes, such as *b152 emotional functions*, have many inclusions as a result of which very different concepts can get mapped onto the same code.

- A term may not match with a specific code but rather with an element of the definition of a code. For example the word '*anxiety***'** provides a match with the content of code b152 *Emotional functions.*

Sometimes the results obtained by using the ICF online browser can be disappointing. Since the browser works on the basis of exactly matched sub-strings, there is a greater probability that shorter strings of individual words will yield matches than longer composite phrases. If individual words are used then the results returned are more likely to contain the sense of the term or phrase of which they are part.

The application of the Linking rules and procedures are illustrated in Section 4 in relation to Guide 71:2001 Human Abilities and a selection of Guide 71:2001 design factors.

**Developing a Core Set of ICF Codes relevant to Universal Design**

The application of the ICF linking rules to a set of terms and concepts can require a substantial amount of time and effort, to the extent that it is unlikely to be either efficient or cost effective to initiate a 'stand alone' linking procedure each time a design term and concept needs to be mapped. The strategy adopted in other fields has been to implement a formal methodology to narrow down the number of ICF Codes considered relevant to the particular area to produce a Core Set of items.

The Core Set can then be field tested to ensure that the content is sufficient and valid for its intended application. This methodology was described in Section 1.4

Given the explicit link proposed by the WHO between Universal Design and the prevention of participation restriction, there is a compelling case to be made for developing a Universal Design Core Set.

This could be achieved in two stages.

- In the first stage, a Universal Design ICF Short Set could be developed by design standards developers using the linking rules. This would reduce the number of ICF Codes to be queried by design developers to a more manageable level.

- In the second stage, a Universal Design ICF Core Set could be generated using the methodology recommended by the ICF Research Branch. This stage should be implemented in cooperation with the WHO to ensure a formal status for the resulting Core Set.

This was a strong recommendation emerging from the international review which was subsequently supported in discussions with design guidance standards developers. Moreover, the development of a Universal Design ICF Core Set is a logical progression in establishing a consistent and internationally accepted terminology for Universal Design guidance standards

# 4. Application of the linking principles to Guide 71

In this section the ICF domains Body Functions, Activities and Participation and Environmental Factors are mapped to Guide 71:2001 Clause 8 – Design Factors and Clause 9 – Human Abilities.

## 4.1 Linking Guide 71 Human Abilities to ICF

In Clause 9, Guide 71:2001 discusses human abilities and the consequences of impairment. It lists the affect of ageing, design considerations and some risks and hazards associated with reduced capacity for each of the abilities. Since Guide 71:2001 is designed to help standards developers and is not for the development of any specific standard, the description of the abilities in question is at a high level of abstraction.

For example, clause 9.2.2 offers the following description of '*hearing*':

"*Hearing functions relate to sensing the presence of sounds and discriminating the location, pitch, loudness, quality and comprehension of sounds. Hearing loss can range from a mild reduction in hearing to profound deafness*".

The ICF presents a much greater level of detail in respect of '*hearing*' functions. It contains a full subcategory of hearing function codes, ranging from *Sound Detection* (b2300) to *Lateralization of Sound* (b2303).

The key challenge is to map to the ICF at the appropriate level of abstraction. Given Guide 71:2001 uses a high level of conceptualisation, it was decided to map to the ICF using its two level classification. In order to maintain mapping consistency, it was decided to map Human Abilities only to ICF body function codes (b codes) and not to use activity codes (d codes).

The result of the application of the linking rules to the human abilities specified in Guide 71:2001 is presented below. All terms and concepts can be mapped to ICF body function codes. However, some are mapped with greater accuracy and more intuitively than others. For example, compare '*Seeing*' with '*Dexterity*'. '*Seeing*' is mapped to *b210 Seeing Functions* whereas '*Dexterity*' is mapped to three codes related to joint mobility. The result revealed many very good links.

## Linking ISO Guide 71:2001 Human Functions (Abilities) Terminology to ICF Body Function Categories Using a Two Level Classification

### 9.2 Sensory Human Abilities

| | | |
|---|---|---|
| • G71 <Seeing> 9.2.1 | & | ICF (Seeing Functions) b210: |
| • G71 <Hearing> 9.2.2 | & | ICF (Hearing Functions) b230: |
| • G71<Touch> 9.2.3 | & | ICF (Touch Function) b265: |
| • G71<Taste/Smell> 9.2.4 | & | ICF (Taste Function) b250 & ICF (Smell Function) b255: |
| • G71<Balance> 9.2.5 | & | ICF (Vestibular Functions) b235: |

### 9.3 Physical Human Abilities

| | | |
|---|---|---|
| • G71<Dexterity> 9.3.1 | & | ICF (Mobility of Joint Functions) b710 & ICF (Mobility of Bone Functions) b720 & ICF (Muscle Power Functions) b730: |
| • G71<Manipulation> 9.3.1 | & | ICF (Mobility of Joint Functions) b710 & ICF (Mobility of Bone Functions) b720 & ICF (Muscle Power Functions) b730: |
| • G71<Movement> 9.3.3 | & | ICF (Motor Reflex Functions) b750 & ICF (Control of Voluntary Movement Functions) b760 & ICF (Involuntary Movement Functions) b765: |
| • G71<Strength> 9.3.4 | & | ICF (Muscle Power Functions) b730 & ICF (Muscle Tone Functions) b735 & ICF (Muscle Endurance Functions) b740: |
| • G71<Voice> 9.3.5 | & | ICF (Voice Functions) b310 & ICF (Articulation Functions) b320 & ICF (Fluency and Rhythm of Speech Functions) b330: |

### 9.4 Cognitive Human Abilities

| | | |
|---|---|---|
| • G71<Intellect> 9.4.2 | & | ICF (Intellectual Functions) b117: |
| • G71<Memory> 9.4.3 | & | ICF (Memory Functions) b114: |
| • G71<Language/Literacy> 9.4.2 | & | ICF (Mental Functions of Language) b167: |

**9.5 Allergies**

| | | |
|---|---|---|
| • G71<Contact Allergies> 9.5.2 | & | ICF (Immunological System Functions) b435 & ICF (Protective Functions of Skin) b810: |
| • G71<Food Allergies> 9.5.3 | & | ICF (Immunological System Functions) b435 & ICF (Digestive Functions) b515: |
| • G71<Respiratory Allergies> 9.5.4 | & | ICF (Immunological System Functions) b435 & ICF (Respiration Functions) b440 & ICF (Respiratory Muscles Functions) b445: |

## 4.2 Additional Codes relevant to Guide 71:2001 Human Abilities

One of the issues highlighted by this exercise is that there are clearly more human abilities that could be included in Guide 71:2001, particularly in relation to cognitive functions. This is reflected in assessment instruments such as AMPS.[31] Implementing the linking process through the ICF highlighted many additional codes that could be relevant. For example, the intellect and memory human abilities could be augmented with a number of additional functions. The most relevant of these are listed below.

**Additional Mental Functions codes relevant to design**

| | |
|---|---|
| b110 | Consciousness function |
| b1101 | Continuity of consciousness |
| b114 | Orientation functions |
| b1140 | Orientation to time |
| b117 | Intellectual functions |
| b140 | Attention functions |
| b1400 | Sustaining attention |
| b1401 | Shifting attention |
| b1402 | Dividing attention |
| b144 | Memory functions |
| b1440 | Short-term memory |
| b1441 | Long-term memory |
| b1442 | Retrieval of memory |
| b147 | Psychomotor functions |
| b1470 | Psychomotor control |
| b1471 | Quality of psychomotor functions |
| b156 | Perceptual functions |
| b1560 | Auditory perception |
| b1561 | Visual perception |
| b1562 | Olfactory perception |
| b1563 | Gustatory perception |

| | |
|---|---|
| b1564 | Tactile perception |
| b1565 | Visuo-spatial perception |
| b1601 | Form of thought |
| b1603 | Control of thought |
| b164 | Higher-level cognitive functions |
| b1640 | Abstraction |
| b1646 | Problem-solving |
| b167 | Mental functions of language |
| b1670 | Reception of language |
| b16700 | Reception of spoken language |
| b16701 | Reception of written language |
| b16702 | Reception of sign language |
| b172 | Calculation functions |
| b176 | Mental function of sequencing complex movements |
| b180 | Experience of self and time functions |
| b1800 | Experience of self |
| b1801 | Body image |
| b1802 | Experience of time |

Similarly, other abilities such as seeing, hearing and voice may also be expanded.

**Additional Sensory Function codes relevant to design**

| | |
|---|---|
| b2100 | Visual acuity functions |
| b21000 | Binocular acuity of distant vision |
| b21002 | Binocular acuity of near vision |
| b2101 | Visual field functions |
| b2102 | Quality of vision |
| b21020 | Light sensitivity |
| b21021 | Colour vision |
| b21022 | Contrast sensitivity |
| b21023 | Visual picture quality |
| b215 | Functions of structures adjoining the eye |
| b230 | Hearing functions |
| b2300 | Sound detection |
| b2301 | Sound discrimination |
| b2302 | Localisation of sound source |
| b2303 | Lateralization of sound |
| b2304 | Speech discrimination |
| b240 | Sensations associated with hearing and vestibular function |
| b2400 | Ringing in ears or tinnitus |
| b2401 | Dizziness |
| b280 | Sensation of pain |
| b310 | Voice functions |
| b310 | Voice functions |
| b3100 | Production of voice |
| b320 | Articulation functions |

The same principle applies to the other human functions which may also be expanded. There is a case here for using more ICF concepts in expanding the list of human abilities under consideration.

In this section human abilities were mapped to ICF codes. In the next section the mapping of Guide 71:2001 design factors to ICF codes is considered.

## 4.3 Linking Guide 71:2001 Design Factors to ICF and related resources

The Guide 71:2001 Clause 8 Design Factors are effectively environmental constructs in that they specify attributes of products, services or the built environment that can be applied to expand the range of users for whom they are suitable. One of the areas in which ICF needs to be augmented is representing characteristics of products.[32] This implies that only a weak mapping may be made with regard to design factors. Most of the links identified refer only to vague services systems and policy. This highlights the need to strengthen the ICF in this regard.

### Linking ICF Environmental Codes to Guide 71:2001 Design Factors

| | | |
|---|---|---|
| • G71 <Alternative format> 8.2 | & | ICF (Communication services, systems and policies) e535 & ICF (Civil Protection services, systems and policies) e545: |
| • G71 <Location and layout of information and controls and positioning of handles> 8.3 | & | ICF (Services systems and policies for the production of consumer goods) e510 & ICF (Architecture and construction services systems and policies) e515 & ICF (Communication services, systems and policies) e535: |
| • G71 <Lighting levels and glare> 8.4 | & | ICF (Light) e240 & ICF (Architecture and construction services systems and policies) e515 & ICF (Civil Protection services, systems and policies) e545: |
| • G71 < Colour and contrast> 8.5 | & | ICF (Light) e240 & ICF (Communication services, systems and policies) e535: |
| • G71 <Size and style of font and symbols in information, warnings and labelling of controls> 8.6 | & | ICF (Communication services, systems and policies) e535 & ICF (Civil Protection services, |

| | | |
|---|---|---|
| | | systems and policies) e545: |
| • G71 < Clear language in written or spoken information> 8.7 | & | ICF (Communication services, systems and policies) e535: |
| • G71 <Graphical symbols and Illustrations> 8.8 | & | ICF (Communication services, systems and policies) e535: |
| • G71 <Loudness and pitch of non-spoken communication> 8.9 | & | ICF (Sound) e250 & ICF (Communication services, systems and policies) e535: |
| • G71 <Slow pace of information Presentation> 8.10 | & | ICF (Communication services, systems and policies) e535: |
| • G71 <Distinctive form of product, • control or packaging> 8.11 | & | ICF (Services, systems and policies for the production of consumer goods e510: |
| • G71 < Ease of handling> 8.12 | & | ICF (Services systems and policies for the production of consumer goods) e510: |
| • G71 <Expiration date marking> 8.13 | & | ICF (Communication services, systems and policies) e535 & ICF (Civil Protection services, systems and policies) e545 & ICF (Health services, systems and policies) e580: |
| • G71 <Contents labelling and warning of allergens> 8.14 | & | ICF (Communication services, systems and policies) e535 & ICF (Civil Protection services, systems and policies) e545 & ICF (Health services, systems and policies) e580: |
| • G71 <Surface temperature> 8.15 | & | ICF (Climate) e225 & ICF (Communication services, systems and policies) e535 & ICF (Civil Protection services, systems and policies) e545: |
| • G71 <Accessible routes> 8.16 | & | ICF (Design, construction and building products and technology for public use) e150 & ICF (Design, construction and building products and technology for private use) e155 & ICF (Architecture and construction services systems and policies) e515: |
| • G71 <Logical process> 8.17 | & | ICF (Services systems and policies for the production of consumer goods) e510 |
| • G71 < Surface finish> 8.18 | & | ICF (Design, construction and |

| | | |
|---|---|---|
| | | building products and technology for public use) e150 & ICF (Design, construction and building products and technology for private use) e155 & ICF (Architecture and construction services systems and policies) e515: |
| • G71 <Non-allergenic/ toxic materials> 8.19 | & | ICF (Services systems and policies for the production of consumer goods) e510 & ICF (Civil Protection services, systems and policies) e545 & ICF (Health services, systems and policies) e580: |
| • G71 <Acoustics> 8.20 | & | ICF (Sound) e250 & ICF (Architecture and construction services systems and policies) e515 & ICF (Communication services, systems and policies) e535 |
| • G71 <Fail-safe> 8.21 | & | ICF (Services systems and policies for the production of consumer goods) e510 ICF (Civil Protection services, systems and policies) e545 |
| • G71 <Ventilation> 8.22 | & | ICF (Air Quality) e260 ICF (Civil Protection services, systems and policies) e545 & ICF (Health services, systems and policies) e580: |
| • G71 <Fire safety of materials> 8.23 | & | ICF (Services systems and policies for the production of consumer goods) e510 & ICF (Architecture and construction services systems and policies) e515 ICF (Civil Protection services, systems and policies) e545 |

## Linking ICF Activity and Participation Codes to Guide 71:2001 Design Factors

An analysis of how Guide 71:2001 represents design factors reveals a strong link to the ICF activities domain. In this linking process each design factor was mapped to the ICF Activity and Participation Codes (d codes) upon which it would most likely impact in terms of improving usability for a wider range of

users with different capacities. Annex 3 presents a summary table of the results of a mapping process between the Guide 71:2001 design factors and ICF Activity codes. This process revealed 17 Activity and Participation Codes which are addressed by the Guide 71:2001 design factors.

These ICF Activity and Participation codes (d codes) specify the environmental influences of the design factors. In combination with the human abilities presented in previous sections, these elements cover the three components of Person, Environment and Activity which can be used to define domains in Universal Design guidance. Linking environmental design factors to ICF Activity and Participation codes also provides an opportunity to expand the scope of enquiry to include many other ICF codes which are also facilitated by these design factors. These activities include every day activities such as education, leisure and shopping.

This analysis also revealed a number of ICF Activity and Participation codes (d codes) which were not clearly or adequately addressed by the current Guide 71:2001 design factors. These are listed below.

**Additional Activity and Participation codes relevant to design**

| | |
|---|---|
| d115 | Listening |
| d210 | Undertaking a single task |
| d220 | Undertaking multiple tasks |
| d310 | Communicating with – Receiving - Spoken Messages |
| d315 | Communicating with – Receiving - Nonverbal Messages |
| d320 | Communicating with – Receiving – Formal Sign Language Messages |
| d325 | Communicating with – Receiving - written Messages |
| d330 | Speaking |
| d360 | Using communication devices and techniques |
| d350 | Conversation |
| d440 | Fine hand use |
| d445 | Hand and arm use |
| d460 | Moving around in different locations |
| d570 | Looking after ones health |
| d620 | Acquisition of goods and services |
| d640 | Doing housework |
| d650 | Caring for household objects |

These ICF Codes could be used to inform any revision of the Guide to increase the range of the design factors included and to enhance the range of application of existing design factors.

## Summary

This guidance document has described the reasons underpinning the use of the ICF in the design process and outlined the relationship between the ICF and Guide 71:2001 Human Abilities and Design Factors. Annex 4 provides a short summary of the main concepts covered in this guidance and presents four examples to demonstrate the application of the ICF to represent the three design components of PAE in generating design guidance standards for products, services, ICT and the built environment to ensure accessibility and improving usability for a wider range of people with differing capacities. These are:

1. A product (Toaster),
2. A component of a built environment (Tap/Faucet),
3. A service (Reception Desk),
4. Information and Communications Technology (Mobile Phone).

## Glossary of Terms

**Activity** - the execution of a task or action by an individual (ICF).

**AMPS**- Assessment of Motor and Process Skills.

**AT**- Assistive Technology.

**Body Functions** - the physiological functions of body systems (including psychological functions) (ICF).

**Body Structures** - anatomical parts of the body such as organs, limbs and their components (ICF).

**Capacity** – a construct that describes , as a qualifier, the highest probable level of functioning that a person may reach in a domain in the Activities and Participation List. Capacity is measured in a uniform or standard environment and thus reflects the environmentally adjusted ability of the individual (ICF).

**Core Set –**a reduced number of ICF Codes relevant to a particular health condition or intervention context which has been generated through a rigorous scientific methodology.

**Environmental Factors** - make up the physical, social and attitudinal environment in which people live and conduct their lives (ICF).

**ICF** - International Classification of Functioning Disability and Health.

**IHTSDO** - International Health Terminology Standards Development Organisation.

**Impairments** - problems in body function or structure such as a significant deviation or loss (ICF).

**OmniClass –** a classification system for the construction industry, developed in the US, which is extremely useful for describing many aspects of the physical environment.

**Participation** - involvement in a life situation (ICF).

**Performance** – a construct that describes, as a qualifier, what individuals do in their current environment (ICF).

**Personal Factors** – include gender race, age, fitness, lifestyle, habits, coping styles and other such factors (ICF).

**Short Set** - An ICF Short Set is a reduced number of ICF Codes relevant to the main purpose of an organisation or field which has been generated using the ICF linking rules.

**SNOMED CT** - Systematized Nomenclature of Medicine--Clinical Terms.

**UD** - Universal Design.

**UniClass** – a classification system, which is of UK origin, for the construction industry. It has some very good classification codes, particularly for information elements of the built environment such as warning signs.

**UNCRPD** - UN Convention on the Rights of Persons with Disabilities

**WHO** - World Health Organisation

# Annex 1: A Brief Overview of ICF Domains, Codes and Qualifiers

## ICF Domains and Codes

The ICF characterises disability as the result of an interaction between an individual and the environment across the lifespan using a language and terminology which is positive. It is often referred to as a universal classification of disability in that it is as relevant to a person who needs spectacles to read as it is to someone who is unable to see anything at all. It incorporates both medical and social aspects of disability and is independent of causality so that reduced functioning is treated the same whether due to birth, trauma or ageing. It can document the impact of context (i.e. the physical and psychosocial environment) on people experiencing reduced functioning across cultures and national boundaries.

The domains contained in the ICF are described from the perspectives of Body Functions and Structures; Activities and Participation and Environmental factors that intervene to enable or disable a person. In this way, it can represent useful profiles of an individual's functioning, disability and health in various domains and document the environmental barriers or facilitators. In the ICF disability and functioning are viewed as outcomes of interactions between health conditions and contextual factors (i.e. environmental and personal factors).

The formal definition and the prefix used to denote each component are presented below (WHO 2001, p10)[33].

- **Body functions** (prefix 'b') are the physiological functions of body systems (including psychological functions).
- **Body structures** (prefix 's') are anatomical parts of the body such as organs, limbs and their components. Impairments are problems in body function or structure such as a significant deviation or loss.
- **Activity** (prefix 'd') is the execution of a task or action by an individual.
- **Activity limitations** are difficulties an individual may have in executing activities.
- **Participation** (prefix 'd') is involvement in a life situation.
- **Participation restrictions** are problems an individual may experience in involvement in life situations.
- **Environmental factors** (prefix 'e') make up the physical, social and attitudinal environment in which people live and conduct their lives.

*Personal factors* refer to attributes of the person which are not related to functioning or disability such as age, gender or height. These are not coded in the ICF

Each ICF term is encoded using the appropriate component letter followed by a numeric code (e.g. Seeing Functions are coded as b210, Visual Acuity Functions as b2100 and Binocular Acuity of Distant Vision as b21000). The ICF codes are only complete with the presence of a qualifier. *Qualifiers record the presence and severity of a problem in functioning at the body, person and societal levels* (WHO 2001, p11).[34]

**ICF Qualifiers (Suffixes)**

A 5 point qualifier scale is used by the ICF for Body Function and Body Structures to indicate the extent of limitation, where 0 means no problem and 4 means a complete problem (e.g. a severe impairment of Visual Acuity is indicated as b2100.3) (see Table A1.1). It appears following a decimal point after the code.

**Table A1.1: The primary qualifiers for the domains of body function and structure**

| ICF Domain | Impairment Qualifiers | | | | |
|---|---|---|---|---|---|
| 'b' Codes | None | Mild | Moderate | Severe | Complete |
| Body Function | bXXX.0 | bXXX.1 | bXXX.2 | bXXX.3 | bXXX.4 |
| 's'Codes | None | Mild | Moderate | Severe | Complete |
| Body Structure | sXXX.0 | sXXX.1 | sXXX.2 | sXXX.3 | sXXX.4 |

Two similar 5 point scales are used with Activity and Participation ('d' codes) shown by two digits following a decimal point after a code. The first digit after the decimal point indicates the level of performance of a person in his or her current environment. The second digit after the decimal point denotes his or her capacity to carry out the activity, or participate, based on the inherent or intrinsic attributes of the person (e.g. a moderate limitation in the activity of reading which is resolved by the use of corrective lenses is denoted by d166.02). The performance and capacity qualifiers for Activity and Participation codes are presented in Table A1.2. The digit not shown is depicted by the letter 'y' in the table.

**Table A1.2: The primary qualifiers for the domains of Activity and Participation**

| ICF Domain | | Extent of Limitation | | | | |
|---|---|---|---|---|---|---|
| 'd'Codes | | None | Mild | Moderate | Severe | Complete |
| Activity & Participation | Performance | dXXX.0y | dXXX.1y | dXXX.2y | dXXX.3y | dXXX.4y |
| | Capacity | dXXX.y0 | dXXX.y1 | dXXX.y2 | dXXX.y3 | dXXX.y4 |

ICF Environmental factors are qualified by two 5 point scales, each of which is denoted by the way in which it is linked to the code. One scale denotes that the factor is a barrier. The other scale indicates that it is a facilitator (e.g. the fact that corrective lenses are a complete facilitator can be denoted by e150+4 - General products and technology for personal use in daily living and poor lighting which is a substantial barrier to reading by e2401.3 - Light quality). These are presented in Table A1.3.

**Table A1.3: The primary qualifiers for the domain of Environmental Factors**

| **ICF Domain** | | **Extent of Barrier or Facilitator** | | | | |
|---|---|---|---|---|---|---|
| 'e' Codes | | | | | | |
| Environment | Barrier | None | Mild | Moderate | Substantial | Complete |
| | | eXXX.0 | eXXX.1 | eXXX.2 | eXXX.3 | eXXX.4 |
| | Facilitator | None | Mild | Moderate | Substantial | Complete |
| | | eXXX+0 | eXXX+1 | eXXX+2 | eXXX+3 | eXXX+4 |

While the ICF covers many of the characteristics of the Person, Activity and the Environment, there are areas in which it needs to be augmented. There is no single source that encodes personal factors in a systematic way and so this requires the designer to generate relevant characteristics such as age, gender or stature. Related resources may also be required to describe more detailed environmental factors such as design factors.[35]

# Annex 2: A Detailed Description of the Rules for Linking the ICF to Other Terms and Concepts

## ICF Linking Rules

The ICF is a very comprehensive classification which has many useful constructs. However, to use it effectively, it is necessary to use a systematic set of linking rules to guide the process of mapping terms and concepts to appropriate ICF codes.

Rules for linking to the ICF were proposed by the ICF monitoring body in 2002[36] and these were upgraded in 2005.[37] The original 2002 rules were designed to link health status measures to the ICF. However, when applied beyond the purpose for which they were originally developed, a number of critical issues, as well as the necessity to simplify them, arose. Thus, the original linking rules have been redefined and simplified, and the contexts in which they can be applied have been expanded.

This resulted in a new set of eight rules. These are presented below.

1. Before one links meaningful concepts to ICF categories and codes, one should have acquired a good knowledge of the conceptual and taxonomical fundamentals of the ICF, as well as of the chapters, domains, and categories of the detailed classification, including definitions.
2. Each meaningful concept is linked to the most precise ICF category.
3. Do not use the so-called "other specified" ICF categories, which are uniquely identified by the final code 8. If the content of a meaningful concept is not explicitly named in the corresponding ICF category, the additional information not explicitly named in the ICF is documented.
4. Do not use the so-called "unspecified" ICF categories, which are uniquely identified by the final code 9, but a lower level category.
5. If the information provided by the meaningful concept (term and definition) is not sufficient for making a decision about the most precise ICF category, it should be assigned the code nd (not definable). Special cases of this rule are:
    a. Meaningful concepts referring to health, physical health or mental (emotional) health in general, are assigned nd-gh, nd-ph or nd-mh (not definable-general health, not definable-physical health, not definable-mental health), respectively;
    b. Meaningful concepts referring to quality of life in general are assigned nd-qol (not definable-quality of life).

6. If the meaningful concept is not contained in the ICF, but it is clearly a personal factor as defined in the ICF, the meaningful concept will be assigned pf (personal factor).
7. If the meaningful concept is not contained in the ICF and it is clearly not a personal factor, this meaningful concept is assigned nc (not covered by ICF).
8. If the meaningful concept refers to a diagnosis or a health condition, the meaningful concept will be assigned hc (health condition).

These linking rules have been used effectively in many studies such as in the classification of musculoskeletal disorders and offer a strategic basis for mapping concepts to the ICF.[38]

While there have been many successful crosswalks (linking procedures) to the ICF, it is not a trivial task. Issues arise with incomplete matches, loose matches, complex semantic and syntactic inference and much more.[39] Thus the basic rules need to be extended for application in design related frameworks. These are presented below.

9. Since the linking process cannot guarantee complete semantic equivalence both the original domain term and the linked ICF codes should be recorded together in the resultant documentation produced by the mapping process.

   The terms recorded should include:

   <Source Term > Source Code & (ICF Term) ICF Code &/or [Related Resource] Related Resource Code

   In this way each term is used, the source term, and source code where relevant, the ICF Term(s) and ICF code(s) and, in the case where an additional term is required from a related resource, that term and relevant code. The terms are mapped to each other as expressions of the same or very closely related concepts.

10. Elements which form a meaningful category should be linked where possible to the same ICF domain. For example, functional capabilities of the person should be linked either to Body Function or Activity codes but if possible not to a combined subset of both. This helps maintain a consistent mapping without the conceptual blurring that occurs when domains are shared.
11. Linking should be done where possible at the same classification level. This provides more conceptual consistency. The ICF offers three classification levels, One, two and a detailed classification with definition levels. The mapping to the ICF should broadly take place at one of these levels and this should be chosen a priori.

12. The amount of detail appropriate for the mapping should be strongly influenced by the source terms and concepts and the application domain. The general principle to be followed is to use sufficient detail to describe the source concept.
13. When the ICF cannot provide an appropriate code, alternates from other sources such as the Systematized Nomenclature of Medicine - Clinical Terms (SNOMED-CT) should be suggested.[40] This would be particularly important when concepts which are not defined in the ICF such as Personal Factors are encountered. Similarly, for poorly defined concepts in the ICF such as some components of the built environment alternatives such as OmniClass or UniClass provide valid reference frameworks. [41] [42]

In summary, when linking design terminology to the ICF, rules 1-8 based on international best practise, should be followed by using Cieza's rules. These, however, should be augmented with the additional five rules (9-13) described above.

**An Example of Linking to the ICF and a Related Resource**

For some applications, the ICF environmental codes are lacking in detail. A stronger representation of activity or the environment could be achieved using a resource like SNOMED-CT together with the ICF.

Table A2.1 presents two examples using the ICF and SNOMED-CT to achieve a more precise match of codes and concepts. In the first example the activity is shopping with a credit card. The ICF Code d2600 captures an element of the activity but it is generic to all types of shopping activities. SNOMED-CT can augment the link because it has a specific code and concept for using a credit card.

**Table A2.1: An Example of Linking Using the ICF with a Related Resource (SNOMED-CT)**

| | | | |
|---|---|---|---|
| **Activity** | | | |
| <Shopping with a Credit Card> | & | ICF (Shopping) d2600 | & |
| | | SNOMED-CT [Using a Credit Card] Code: 441830018 | |
| **Environment** | | | |
| <Well lit reception room> | & | ICF (Light quality in a space) e2401 | & |
| | | SNOMED-CT [Reception room] Code: 224690008: | |

The second environmental example refers to a well lit reception room. Once again ICF provides a generic code for light quality in a space but is not specific to a reception room. Once again SNOMED-CT provides an appropriate code for reception room.

While SNOMED-CT can provide a code for reception room there are other resources which can also be considered such as the OmniClass Construction Classification System (known as OmniClass™ or OCCS). OCCS is a classification system for the construction industry that defines building types and spaces. It is intended to be an open standard, freely available to all and has numerous tables that are useful in classifying and representing terms for design elements as components of the built environment. For example, the OmniClass Code 13-55 29 23 11 for a Reception Space is defined to be "*A waiting area, such as a lobby or front office desk of an organization or business*".

## An Approach to Integrating Personal Factors to Other Terms and Concepts

While Activity, Environment, Body Function and Body Structure codes are defined in the ICF, Personal Factors (PF) are not. Personal factors are the particular background of an individual's life and living which comprise attributes of the individual that are not part of a health condition or health status. These factors may include gender, race, age, other health conditions, fitness, lifestyle, habits, upbringing, coping styles, social background, education, profession, past and current experience (past life events and concurrent events), overall behaviour patterns and character style, individual psychological assets and other characteristics, all or any of which may impact on access and usability.

Personal factors are not classified in ICF. However, significant work is being done by ICF researchers lead by Szilvia Gehy to identify personal factors with a view to establishing this domain in future revisions of the ICF.[43] The specific aims of Gehy's work are to identify papers that contain information about the ICF and explicitly mention Personal Factors, to analyse Personal Factor-related content of the papers and to gain an overview of the notion of Personal Factors in the literature. These include factors such as esteem, motivation, self-efficacy, and expectations, amongst others.

Many of these Personal Factors such as consumer expectations are important in the consumer experience of everyday products and can influence their success or failure. It is possible that any guidance document on design may wish to include these factors as part of guidance standards.

Since the ICF has not defined Personal Factor codes, it is suggested that any mapping to the ICF of Universal Design Guidance principles follow Cieza's rule

for documenting these factors which suggests that labels representing Personal Factors be augmented by a pf- Prefix, e.g. pf-Self-Efficacy.

**Issues to be Addressed in Linking ICF to Other Terms and Concepts**

At the heart of any Universal Design initiative are the key variables of Person, Environment and Activity. On first appearances, the ICF seems well equipped to model these central concerns in an effective and meaningful way. In representing Person, the ICF offers extensive Body Functions and Structures code categories. Similarly, the notions of Activity and Environment appear to be covered by the ICF Activity and Participation codes and its Environmental factor codes.

However, as indicated by other work, matching ICF codes to any concept faces challenges (Reed *et al*, 2005).[44] The problems identified include:

- There is rarely a one to one correspondence between instruments and ICF;
- A single source term may match onto many ICF items;
- Many terms and concepts may match onto a single ICF code;
- Most analyses are likely to yield information that is far more detailed than that which can be categorized by the ICF classification;
- Some codes overlap with each other or seem to be very similar or redundant.

From the perspective of clinical assessment, some codes can be differentiated conceptually but the distinction between them is not clinically meaningful for assessment, description, or treatment. The ICF's use of a standard environment when assessing capacity presents a variety of difficulties and there are issues with the use of ICF qualifiers.

Table A2.2 summarises many of the issues involved in using the ICF. For example, a major issue faced when using the ICF, is that in representing activity, the same ICF codes must be used to reflect many different situations with no means to distinguish these different instances of the same code.[45]

Another major issue is the level of detail required to describe the Person and how many of the 1400 ICF codes are needed. Consider the activity of walking short distances, which is a competence required in making tea. The tea maker has to walk to and from the sink.

Browsing the ICF classification yields hundreds of possible codes which may be applied to the specification of this task of making tea. There are Body Functions and Body Structure codes related to mobility. There are Activity codes related to the activity of walking and moving around. There are environmental factors such as building component design codes and lighting codes and so on which are also

relevant. There are issues with both the natural and man-made physical environments which will impact on walking. Attitudes of others may impact on this and finally policy and legal mandates may facilitate the walking experience. For all these there are many relevant ICF codes.

The challenge is to determine the amount of detail which is required. The dilemma is whether to use all of the above codes or to use one single activity code for walking. It is a question of how detailed record of related body function and structures is really necessary. The decision will depend on the application and discretion must be applied. For example, some relevant AT interventions, such as prostheses for various body structures, apply at very specific levels. When considering these a very detailed and comprehensive set of codes will be required. In more general design initiatives a more limited set of codes may be sufficient.

**Table A2.2: ICF Linking Issues**

| **Concept** | **Issues in linking to ICF** |
|---|---|
| General | - Finding the appropriate ICF code.<br>- Choosing between many apparently relevant codes.<br>- How much detail to use.<br>- Making very tenuous links. |
| Person | - Trying to represent MPT items using ICF<br>- Anthropometric Data<br>- Using the same code to represent many very different instances of the same capacity<br>- Whether to just include all codes or just those where there was any significant difference in qualifier values from the norm |
| Environment (and objects) | - How to represent the physical environment with all its objects including representing spatial relationships and associations and issues to do with inheritance such as component parts of objects and spaces.<br>- How to use the ICF to represent the interaction required with different objects<br>- Many ICF codes can be left independent of any of the other components of Assistive Technology systems. |
| Activity | - Differentiation between different instances of the same activity. The same ICF code is used regardless of the sometimes widely varying nature of these acts.<br>- The lack of clear distinction between activity and participation is confusing |
| Assistive Technology | - AT is only considered by the ICF in an extremely general way. |

An area where the ICF clearly requires to be augmented is with regard to Personal Factors, such as stature or age. A decision was made when developing the ICF that personal factors would not be incorporated into the coding system. As a result

there are no ICF codes with which to represent personal characteristics that may impact on the use of a service, product or built environment.

In spite of all these challenges, the ICF can be used to enhance the clarity of design terms and concepts.

# Annex 3: Linking ICF Activity and Participation Codes to Guide 71:2001 Factors

| | d115 Listening | d210 Undertaking a single task | d220 Undertaking multiple tasks | d310 Communicating with – Receiving - Spoken Messages | d315 Communicating with – Receiving - Nonverbal Messages | d320 Communicating with – Receiving – Formal Sign Language Messages | d325 Communicating with – Receiving - written Messages | d330 Speaking | d360 Using Communication Devices and Techniques | d350 Conversation | d440 Fine Hand use | d445 Hand and arm use | d460 Moving Around in Different locations | d570 Looking after ones health | d620 Acquisition of goods and services | d640 Doing Housework | d650 Caring for Household objects |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8.2 Alternative format | | | | I | I | I | I | | | | | | | | | | |
| 8.3 Location and layout of information and controls and positioning of handles | | | | I | I | I | I | | | | I | I | | | I | I | I |
| 8.4 Lighting levels and glare | | | | I | I | I | I | | | | I | I | | | I | I | I |
| 8.5 Colour and contrast | | | | I | I | I | I | | | | | | | | | | |
| 8.6 Size and style of font and symbols in information, warnings and labelling of controls | | | | I | I | I | I | | | | | | | | | | |
| 8.7 Clear language in written or spoken information | | | | I | I | | | | | | | | | | | | |
| 8.8 Graphical symbols and illustrations | | | | | I | | I | | | | | | | | | | |
| 8.9 Loudness and pitch of non-spoken communication | | | | | I | | | | | | | | | | | | |

| | d115 Listening | d210 Undertaking a single task | d220 Undertaking multiple tasks | d310 Communicating with – Receiving - Spoken Messages | d315 Communicating with – Receiving - Nonverbal Messages | d320 Communicating with – Receiving – Formal Sign Language Messages | d325 Communicating with – Receiving - written Messages | d330 Speaking | d360 Using Communication Devices and Techniques | d350 Conversation | d440 Fine Hand use | d445 Hand and arm use | d460 Moving Around in Different locations | d570 Looking after ones health | d620 Acquisition of goods and services | d640 Doing Housework | d650 Caring for Household objects |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8.10 Slow pace of information presentation | | | | I | I | I | I | | | | | | | | | | |
| 8.11 Distinctive form of product, control or packaging | | | | | I | | | | | | I | I | | | I | I | I |
| 8.12 Ease of handling | | | | | | | | | | | I | I | | | I | I | I |
| 8.13 Expiration date marking | | | | | I | | I | | | | | | | | | | |
| 8.14 Contents labelling and warning of allergens | | | | | I | | I | | | | | | | | | | |
| 8.15 Surface temperature | | | | I | I | I | I | | | | | | | | | | |
| 8.16 Accessible routes | | | | | | | | | | | | | I | | | | |
| 8.17 Logical process | | I | I | | | | | | | | | | | | | | |
| 8.18 Surface finish | | | | | | | | | | | I | I | | | | I | |
| 8.19 Non-allergenic/toxic materials | | | | I | I | I | I | | | | | | | | | | |
| 8.20 Acoustics | I | | | | | | | I | I | I | | | | | | | |
| 8.21 Fail-safe | | | | | | | | | | | | | I | I | | | |
| 8.22 Ventilation | | | | | | | | | | | | | | I | | | |
| 8.23 Fire safety of materials | | | | | | | | | | | | | I | I | | | |

# Annex 4 Summary Guidance and Examples

# The Application of the World Health Organisation's International Classification of Functioning, Disability and Health (ICF) to Universal Design Guidance Standards: Summary Guidance and Examples

*Prepared for*

Centre for Excellence in Universal Design

National Disability Authority

25 Clyde Road

**30th October 2012**

The National Disability Authority (NDA) has funded this project. Responsibility for the project (including any errors or omissions) remains with the Work Research Centre. The views and opinions contained in the report are those of the authors and do not necessarily reflect the views or opinions of the National Disability Authority (NDA)

**Table of Contents**

# The Application of the World Health Organisation's International Classification of Functioning, Disability and Health (ICF) to Universal Design Guidance Standards

**Introduction:**

In the introduction to ISO 26800:2011 Ergonomics - General Approach, Principles and Concepts, it is acknowledged that accurate terminology which is based on internationally agreed language is fundamental to design. This is particularly important where human involvement is expected.[1]

This document explains how the International of Classification of Functioning, Disability and Health (ICF) can be applied to three interacting design components, the Person, the Activity and the Environment (PAE) in the development of design guidance standards to achieve accurate and consistent terminology.

It is intended to provide an overview of how using the ICF can result in a more precise, consistent and internationally recognised language and terminology to represent the interaction of PAE in design including:

- Developing design guidance standards,
- Making design decisions,
- Preparing design specifications,
- Evaluating design proposals, and
- Promoting Universal Design.

In addition, it contains examples to demonstrate the application of the ICF to represent the three design variables of PAE in relation to:

1. A product (Toaster),
2. A component of a built environment (Tap/Faucet),
3. A service (Reception Desk),
4. Information and Communication Technology (ICT) (Mobile Phone).

This document is based on a research project involving an international review which considered in particular the application of the ICF to design activities and the development of a Guidance document on integrating optimal terminology and

[1] ISO 26800:2011 Ergonomics -- General approach, principles and concepts, Available at: http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=42885

classifications to improve design guidance standards. A PowerPoint presentation, which was prepared for the ISO/IEC Guide 71 JTAG Dublin in October 2012 to provide an overview of the project is included in Appendix B.

**Person, Activity and Environment:**

Taking account of the interaction of the three components Person, Activity and the Environment (PAE) is key to understanding, representing and communicating design concepts relating to products, services or the built environment. By addressing each of these in relation to design, the impact on accessibility and usability can be specified in a detailed and consistent manner.

- **Activity** refers to what a person must do to use a product, service or built environment.
- **Person** refers to the mental and physical functions and personal characteristics that may impact on carrying out an activity.
- **Environment** refers to the design factors, including physical, structures, social and attitudinal factors, that may act as facilitators or barriers to a person's performance in using products, services or the built environment.

**The Application of the ICF to Design:**

One of the intended applications of the ICF is environmental assessment for Universal Design (WHO 2001).[2] It can be used to apply a consistent and internationally agreed classification and terminology to represent design concepts. Appendix A provides an overview of the domains of the ICF and the way in which terms are coded and applied.

The ICF framework has five main components. Four of these are classified using codes to represent a different aspect of the person and the environment. The classification consists of *Body Functions* (b codes); *Body Structures* (s codes); *Activity and Participation* (d codes) and *Environment* (e codes). The fifth component is *Personal Factors* (pf) which are not encoded within the Classification.

Identifying appropriate ICF codes for design terms and concepts is governed by a set of linking rules. These are described in more detail in the Guidance on the Application of the ICF and Related Resources to Improve Universal Design Guidance Standards. The most relevant rules are:

[2] WHO (2001)*Towards a Common Language for Functioning, Disability and Health: ICF*, World Health Organisation, Geneva, http://www.who.int/classifications/icf/training/icfbeginnersguide.pdf

- A prerequisite for accurate and appropriate linking is a working knowledge of the ICF.[3]
- A term and its related concept should be linked to the most precise ICF category.
- Where no corresponding ICF code is found do not use the so-called "other specified" ICF categories but document the additional information.
- The original domain term and the matching ICF code(s) should be recorded together in the resultant documentation produced by the mapping process.
- When the ICF cannot provide an appropriate code, alternates from other sources should be sought. While the ICF provides detailed codes for some of these, it is necessary in some cases to augment it using related resources particularly in relation to more detailed environmental concept and personal characteristics.

[3] International Classification of Functioning, Disability and Health (ICF): WHO – FIC Information Sheet September 2010. Available at: http://www.ifhima.org/docs/ICF%20%20Information%20sheet%2029112010.pdf

## Example 1:

### The Application of the ICF Terminology to Toaster Design Terminology

The table below presents a way to organise the three interacting components (PAE) and the associated ICF terminology in the design of a rotary toaster time control knob.

The first column of the table represents the three components of Person, Activity and Environment. The second and third columns specify the domain and source of the terms used. The fourth column contains the descriptive terms. The final column specifies the associated code (where this is available).

The last row of the table indicates the design features which can be used to facilitate accessibility and usability.

A small, smooth control knob can be difficult to grip for anyone with wet hands or a limitation in grasping and twisting. Easy to grasp and twist knobs facilitate an improvement in performance.

Poor colour contrast on the scale of the rotary control knob, as shown in the adjacent image of a toaster, can make it difficult for all people to use the control effectively. Good colour combinations help to provide good contrast between the control and the gradient display.

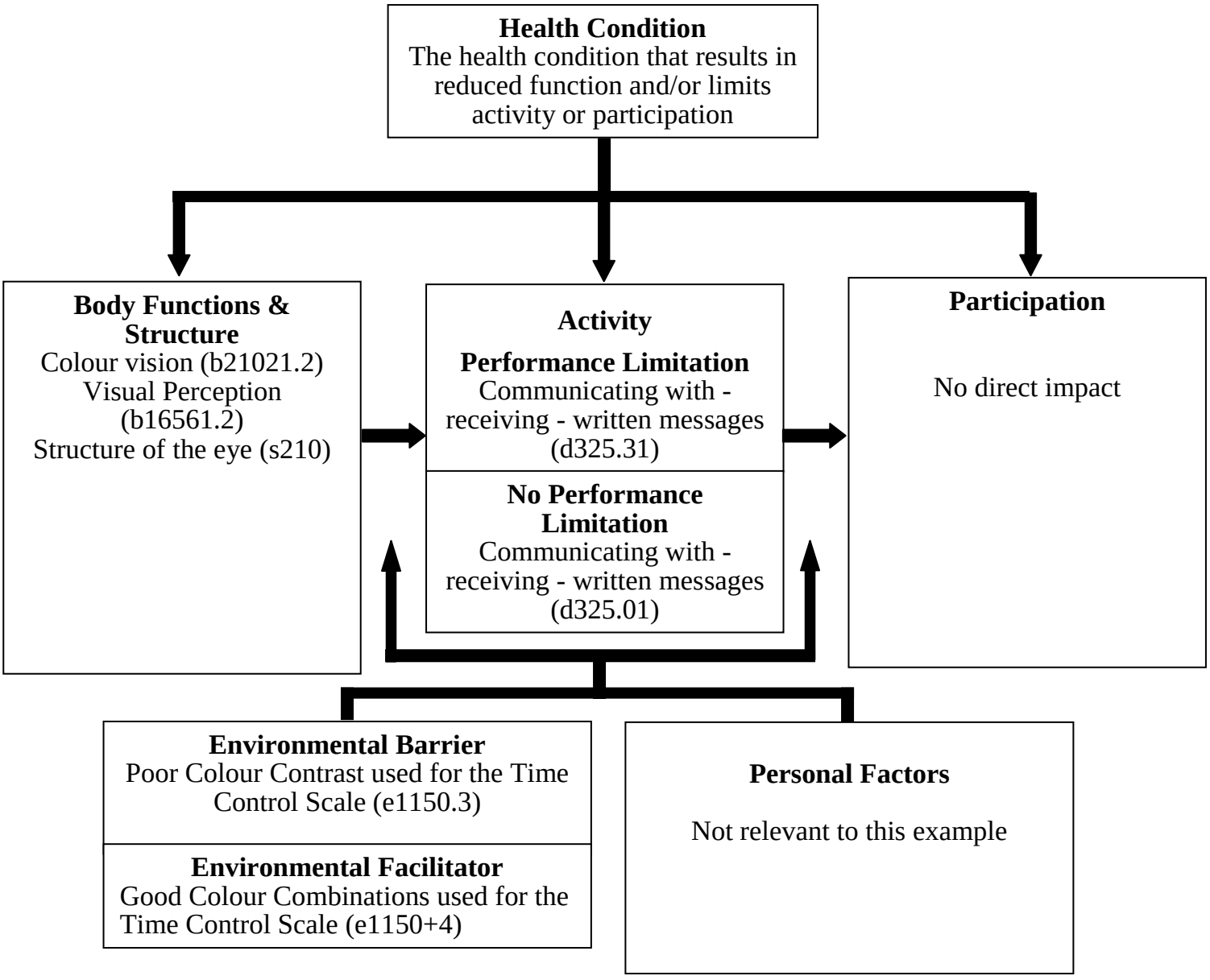

The table below illustrates the way in which using the ICF to specify the three PAE components and their interaction can assist in the definition of potential environmental barriers and the identification of design factors that can facilitate wider accessibility and usability.

**Product:** **Toaster**
**Task or Goal:** **Adjusting the time setting for toasting bread**
**Operational Component:** **Rotary Control Knob**

| PAE Variable | ICF Domains | Source of Terms | Descriptive Terms | Code |
|---|---|---|---|---|
| Activity | Activities (Tasks) | ICF | Communicating with-receiving-written messages | d325 |
| | | | Manipulating | d4402 |
| | | | Reaching | d4452 |
| | | | Grasping | d4401 |
| | | | Turning or twisting | d4453 |
| | | Non-ICF | * | |
| Person | Body Functions | ICF | Joint mobility | b710 |
| | | | Colour vision | b21021 |
| | | | Visual Perception | b16561 |
| | | Non-ICF | * | |
| | Body Structures | ICF | Structure of the Hand | s7302 |
| | | | Structure of the eye | s210-s220 |
| | | Non-ICF | * | |
| | Personal Factors | | * | |
| Environment | Environmental Barriers | ISO/IEC TR22411 | Poor Colour Contrast | 8.5.2 |
| | | | Hard to grip knob | 8.12.3.1 |
| | Environmental Facilitators (Universal Design Factors) | ISO/IEC TR22411 | Good Colour combinations between control and time gradients | 8.5.2 |
| | | | Easy to grasp and twist control knob - Ease of handling | 8.12.3.1 |

* Non-ICF and Personal Factors were not considered relevant to this example

For illustration purposes the diagram below uses the ICF framework to represent the way in which the absence of the Universal Design Factor, good colour contrast, can act as a barrier to a person with a moderate seeing impairment in differentiating colours. The ICF has a system of qualifying scales (values are shown as suffixes separated from the code by a decimal point or plus sign) that are explained in Appendix 1. The diagram is explained in the text below it.




- The Health Condition box at the top of the figure indicates the health condition that is impacting on Body Functions, Structures, Activity or Participation. This is not coded in the ICF but is classified using the

International Classification Diseases 10th Edition (ICD 10). There is no relevant health condition in this example.

- The Body Functions and Structures relevant to using the scale on a rotary toaster time control knob are specified in the box on the left hand side of the diagram. In this example, the person has a moderate impairment of colour vision (b20012.2) relating to the structure of the eye indicated by the qualifier XXX**.2**.

- The central box lists the Activity involved in using the scale on a rotary toaster time control knob - Communicating with - receiving - written messages (d325).
    - The top part of the box indicates a limitation. The first qualifier XXX **.3_** indicates that the person is experiencing a severe limitation in the performance of reading the written symbols on the toaster as a result of poor colour combinations (see environmental barrier box) and the second qualifier XXX**._1** indicates that he or she would experience a mild limitation in the capacity to perceive written messages in colour based on his/her inherent or intrinsic attributes (d325.31).
    - The bottom part of the box indicates that the person has no difficulty reading the symbols as a result of good colour combinations in the design of the scale. No limitation in performance of the activity is indicated by the performance qualifier XXX.**0_**. The capacity qualifier would remain the same XXX**._1** (d325.01).

- The right hand box indicates that in this activity there is no impact on the person's participation in life situations.

- The Environmental Factor is listed in the left hand lower box.
    - In the upper part of the box - poor colour contrast used on the scale of the rotary toaster control knob – is indicated as a substantial environmental barrier for the person by the qualifier XXX**.3**. The ICF code in the diagram denotes general products and technology for personal use in daily living (e1150.3).
    - In the bottom part of the lower left box, good colour combinations on the scale of the rotary toaster time control knob is indicated by the qualifier XXX **+4** as a complete facilitator (e1150+4).

- The lower right hand box indicates that Personal Factors are not relevant to this example.

## Example 2

### The Application of the ICF Terminology to the Built Environment

The table below presents a way to organise the three interacting components (PAE) and the associated ICF terminology in the design of an attribute of a building -a tap or faucet (water flow control).

The first column of the table represents the three components of Person, Activity and Environment. The second and third columns specify the domain and source of the terms used. The fourth column contains the descriptive terms. The final column specifies the associated code (where this is available).

The last row of the table indicates the design features which can be used to facilitate accessibility and usability.

A tap with round handles, shown in the adjacent image, can be difficult to grip for anyone with soapy hands or with a limitation in grasping and twisting.

Lever style handles, shown in the second image, make it easier to control the flow of water regardless of grip capacity.

The table illustrates the way in which using the ICF to specify the three PAE components and their interaction can assist in the definition of potential environmental barriers and the identification of design factors that can facilitate accessibility and usability.

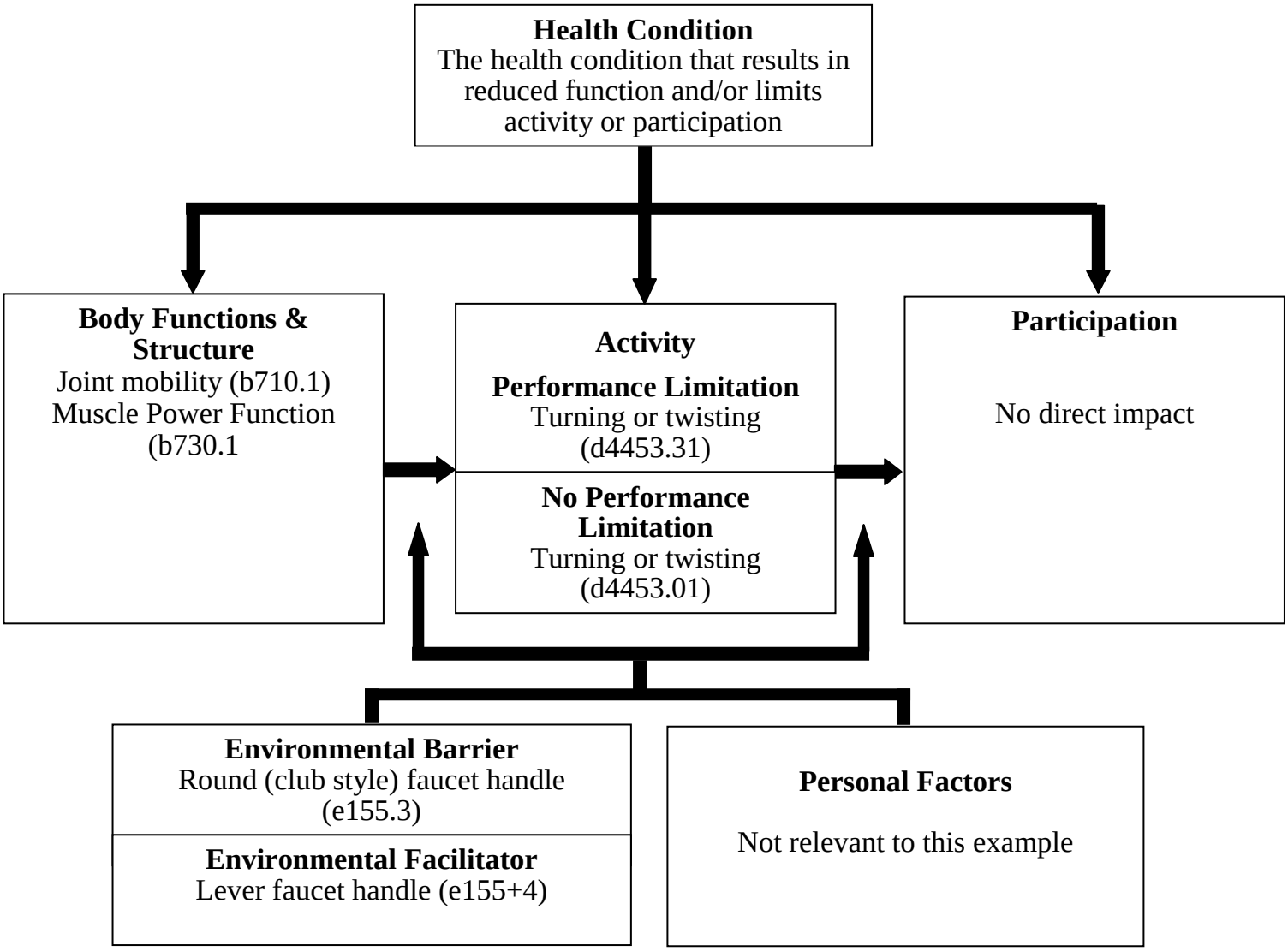
**Product:** **Tap/Faucet**
**Task or Goal:** **Adjusting the flow of water**
**Operational Component:** **Manipulating Tap/Faucet Handles**

| PAE Variable | ICF Domains | Source of Terms | Descriptive Terms | Code |
|---|---|---|---|---|
| Activity | Activities (Tasks) | ICF | Manipulating | d4402 |
| | | | Reaching | d4452 |
| | | | Grasping | d4401 |
| | | | Turning or twisting | d4453 |
| | | Non-ICF | * | |
| Person | Body Functions | ICF | Joint mobility | b710 |
| | | | Muscle Power Function | b730 |
| | | | Control of voluntary Movement Functions | b760 |
| | | Non-ICF | * | |
| | Body Structures | ICF | Structure of upper arm | s7300 |
| | | | Structure of Forearm | s7301 |
| | | | Structure of Hand | S7302 |
| | | Non-ICF | * | |
| | Personal Factors | | * | |
| Environment | Environmental Barriers | ISO/IEC TR22411 | Round hard to grip faucet handle | 8.12.3.1 |
| | Environmental Facilitators (Universal Design Factors) | ISO 21542:2002[4] | Lever Style Faucet Handle | 26.11 |

* Non-ICF and Personal Factors were not considered relevant to this example

[4] ISO 21542:2002 Accessibility and Usability of the Built Environment

For illustration purposes the diagram below uses the ICF framework to represent the way in which the absence of the Universal Design Factor, ease of handling (Guide 71:2001 8.12.3.1), can act as a barrier to a person with a moderate impairment in gripping and twisting. The ICF has a system of qualifying scales (values are shown as suffixes separated from the code by a decimal point or plus sign) that are explained in the Appendix. The diagram is explained in the text below it.




- The Health Condition box at the top of the figure indicates the health condition that is impacting on Body Functions, Structures, Activity or Participation. This is not coded in the ICF but is classified using the International Classification Diseases 10th Edition (ICD 10). In this case a

number of health conditions, including arthritis, cerebral palsy or multiple sclerosis, could result in activity limitations with gripping and twisting.

- The Body Functions and Structures relevant to using the water control on a tap are specified in the box on the left hand side of the diagram. In this example, the person has a mild impairment of joint mobility (b710.1) and muscle power (b730.1) relating to the structure of the hand and arm as indicated by the qualifier XXX**.1**.
- The central box lists the Activity involved in using a tap/faucet handle - Turning or twisting (d4453).
    - The top part of the box indicates a limitation. The first qualifier XXX**.3_** indicates that the person is experiencing a severe limitation in the performance of turning or twisting as a result of the shape of the handles (see environmental barrier box) and the second qualifier XXX**._1** indicates that he or she would experience a mild limitation in the capacity to turn and twist based on his/her inherent or intrinsic attributes (d4453.31).
    - The bottom part of the box indicates that the person has no difficulty in turning or twisting the lever handles. No limitation in performance of the activity is indicated by the performance qualifier XXX**.0_**. The capacity qualifier would remain the same XXX**.1_** (d4453.01).
- The right hand box indicates that there is no impact on the person's participation in life situations.
- The Environmental Factor is listed in the left hand lower box.
    - In the upper part of the box – the round tap handles – are indicated as a substantial environmental barrier for the person by the qualifier XXX**.3**. The ICF code in the diagram denotes design, construction and building products and technology of buildings for private use (e155.3).
    - In the bottom part of the box, the lever handles are indicated by the qualifier **+4** as a complete facilitator (e155+4).
- The lower right hand box indicates that Personal Factors are not relevant to this example.

## Example 3

## The Application of the ICF Terminology to Service Design

The table below presents a way to organise the three interacting components (PAE) and the associated ICF terminology in the design of an attribute of a service – a reception desk.

The first column of the table represents the three components of Person, Activity and Environment. The second and third columns specify the domain and source of the terms used. The fourth column contains the descriptive terms. The final column specifies the associated code (where this is available).

The last row of the table indicates the design features which can be used to facilitate accessibility and usability.

A reception desk is an important aspect of customer service. It is the first point of contact in many services including banks, hotels and health services. People of small stature and those who use wheelchairs often face barriers in relating to service staff behind reception desks which are too high. This interferes with eye contact and effective communication.

A desk with a countertop that is between 700 and 800mm high, as illustrated in the adjacent image, provides a comfortable and welcoming environment which facilitates better participation on the part of the customer.

The table below illustrates the way in which using the ICF to specify the three PAE components and their interaction can assist in the definition of potential environmental barriers and the identification of design factors that can facilitate accessibility and usability.

**Service:** **Health Service**

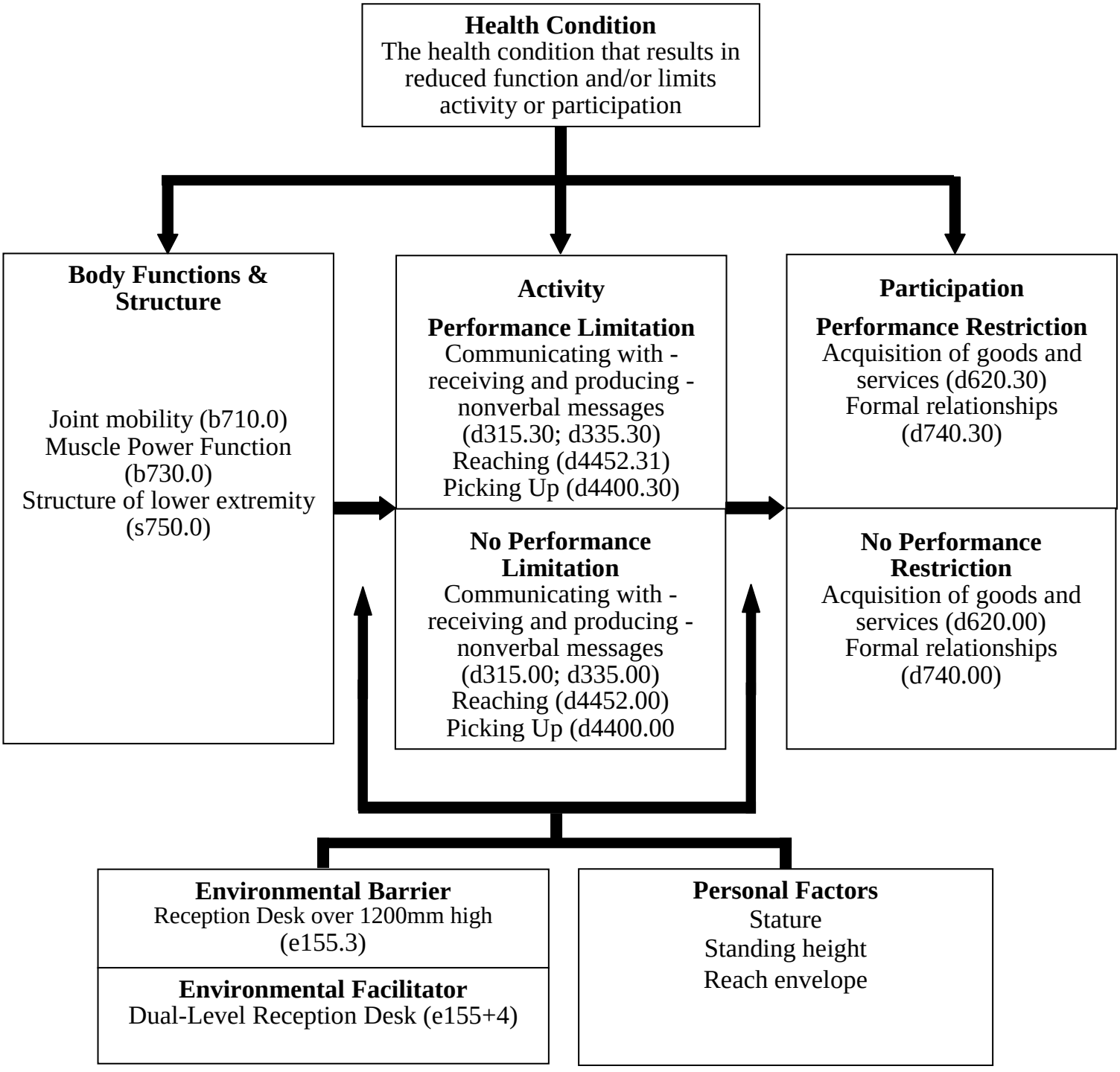
**Task or Goal:** **Making an appointment to see a consultant**

**Operational Component:** **Reporting to the Reception Desk**

| PAE Variable | ICF Domains | Source of Terms | Descriptive Terms | Code |
|---|---|---|---|---|
| Activity | Activities (Tasks) | ICF | Acquisition of Goods and Services | d620 |
| | | | Relating with strangers | d730 |
| | | | Moving around within buildings other than the home | d4601 |
| | | | Reaching | d4452 |
| | | | Picking Up | d4400 |
| | | Non-ICF | Making Eye-contact | |
| Person | Body Functions | ICF | Joint mobility | b710 |
| | | | Muscle Power Function | b730 |
| | | | Orientation to Person | b1142 |
| | | Non-ICF | | |
| | Body Structures | ICF | Structure of lower extremity | s750 |
| | | Non-ICF | * | |
| | Personal Factors | ISO/IEC TR22411 | Stature<br>Standing height<br>Sitting Height<br>Reach envelope | 9.3 Table 17<br>&<br>9.3 Table 19 |
| Environment | Environmental Barriers | OmniClass | Reception Desk over 1200mm high | 23-21111123<br>&<br>49-711921 |
| | | ICF | Lack of Awareness on the part of the receptionist | e445 |
| | Environmental Facilitators (Universal Design Factors) | OmniClass | • Reception desks and service counters with a work surface at two different levels to facilitate use by people at a range of heights and in either a seated or standing position<br>• The lower work surface should be a maximum of 760mm above floor level and have a clearance to the underside of 700mm (Building for Everyone Booklet 6 - Facilities in buildings) | 49-711517 |
| | | ICF | • Diversity training for customer staff | e5850 |

*Not considered relevant to this example

For illustration purposes the diagram below uses the ICF framework to represent the way in which the absence of a dual-level reception desk can act as a barrier to a person of short stature. The ICF has a system of qualifying scales (values are shown as suffixes separated from the code by a decimal point or plus sign) that are explained in the Appendix. The diagram is explained in the text below it.



- The Health Condition box at the top of the figure indicates the health condition that is impacting on Body Functions, Structures, Activity or Participation. This is not coded in the ICF but is classified using the International Classification Diseases 10th Edition (ICD 10). There is no relevant health condition in this example.
- The Body Functions and Structures relevant to using a reception desk are specified in the box on the left hand side of the diagram. In this example, the person has a no impairment of Joint mobility (b710.0) or Muscle Power Function (b730.0) relating to the structure of the lower extremity indicated by the qualifier XXX**.0**.
- The central box lists the activities involved in using a reception desk - Communicating with - receiving - nonverbal messages (d315; d335 Producing nonverbal messages (d335); Reaching (d4452) and Picking Up (d4400).
    - The top part of the box indicates the limitations. The first qualifier XXX**.3_** indicates that the person is experiencing a severe limitation in the performance of communicating with -receiving and producing - nonverbal messages, reaching and picking up as a result of the height of the reception desk (see environmental barrier box) and the second qualifier XXX**._0** indicates that he would experience no limitation in communicating using non-verbal messages (d315.30 and d335.30) or picking up (d4400.30) although he would experience a mild limitation in reaching based on his inherent or intrinsic attributes represented by the qualifier XXX**._1** (d4452.31).
    - The bottom part of the box indicates that the person has no difficulty in performing these activities as indicated by the performance qualifiers XXX**.0_** for all activities.
- The right hand box lists the types of involvement in life situation - Participation that are impacted.
    - The top part of the box indicates the limitations in participation. The person has a severe limitation in participating in the Acquisition of goods and services (d620.30) and in Formal relationships (d740.30) with the receptionist as indicated by the first qualifier XXX**.3_**, although based on his inherent or intrinsic attributes he would have no difficulty doing so represented by the second qualifier XXX **._0** .
    - The bottom part of the box indicates that the person has no difficulty in the acquisition of goods and service and formal relationships indicated by the performance qualifier XXX**.0_** for both areas of participation.
- The Environmental Factor is listed in the left hand lower box.

    - In the upper part of the box – the reception Desk over 1200mm high – is indicated as a substantial environmental barrier for the person by the qualifier XXX**.3**, i.e. Design, construction and building products and technology of buildings for public use (e150.3).
    - In the bottom part of the box, dual-level reception desk is indicated by the qualifier XXX**+4** as a complete facilitator (e155+4).
- The lower right hand box indicates that the Personal Factors: Stature, Standing height and Reach envelope are affecting the person's activity and participation.

## Example 4:

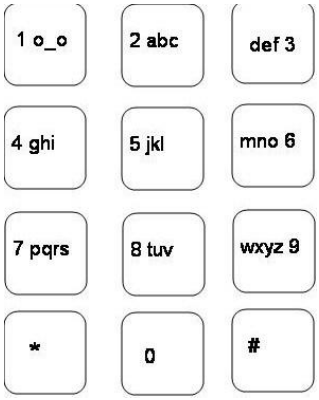
## The Application of the ICF Terminology to Information and Communication Technology (ICT) Design

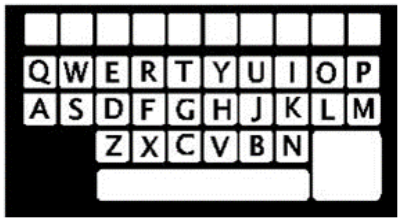
The table below presents a way to organise the three interacting components (PAE) and the associated ICF terminology in the design of an attribute of an ICT device – a mobile phone.

The first column of the table represents the three components of Person, Activity and Environment. The second and third columns specify the domain and source of the terms used. The fourth column contains the descriptive terms. The final column specifies the associated code (where this is available).

The last row of the table indicates the design features which can be used to facilitate accessibility and usability.

A substantial challenge for any ICT user who changes to a new device is coming to terms with the new interfaces, applications and defaults integrated into the new device. Familiarity with previous ways of doing things can act as a barrier to learning how to use the new device efficiently For example, a person, who has been routinely using a standard 4 X 3 telephone keypad array, as shown in the upper image, over an extended period of time will experience difficulties, at least in the early stages, using a QWERTY layout for an onscreen keypad, as shown in the lower image, to operate a mobile phone. This occurs because the routines developed in using the numeric keys 0-9, the symbol keys star (*) and the number sign (#) on the standard telephone keypad interfere with efficient use of a QWERTY keypad which displays all alphabetic and numeric characters. This interference can represent a greater challenge for someone with a learning impairment. Providing an option to select a standard telephone keypad on-screen display could eliminate this difficulty.



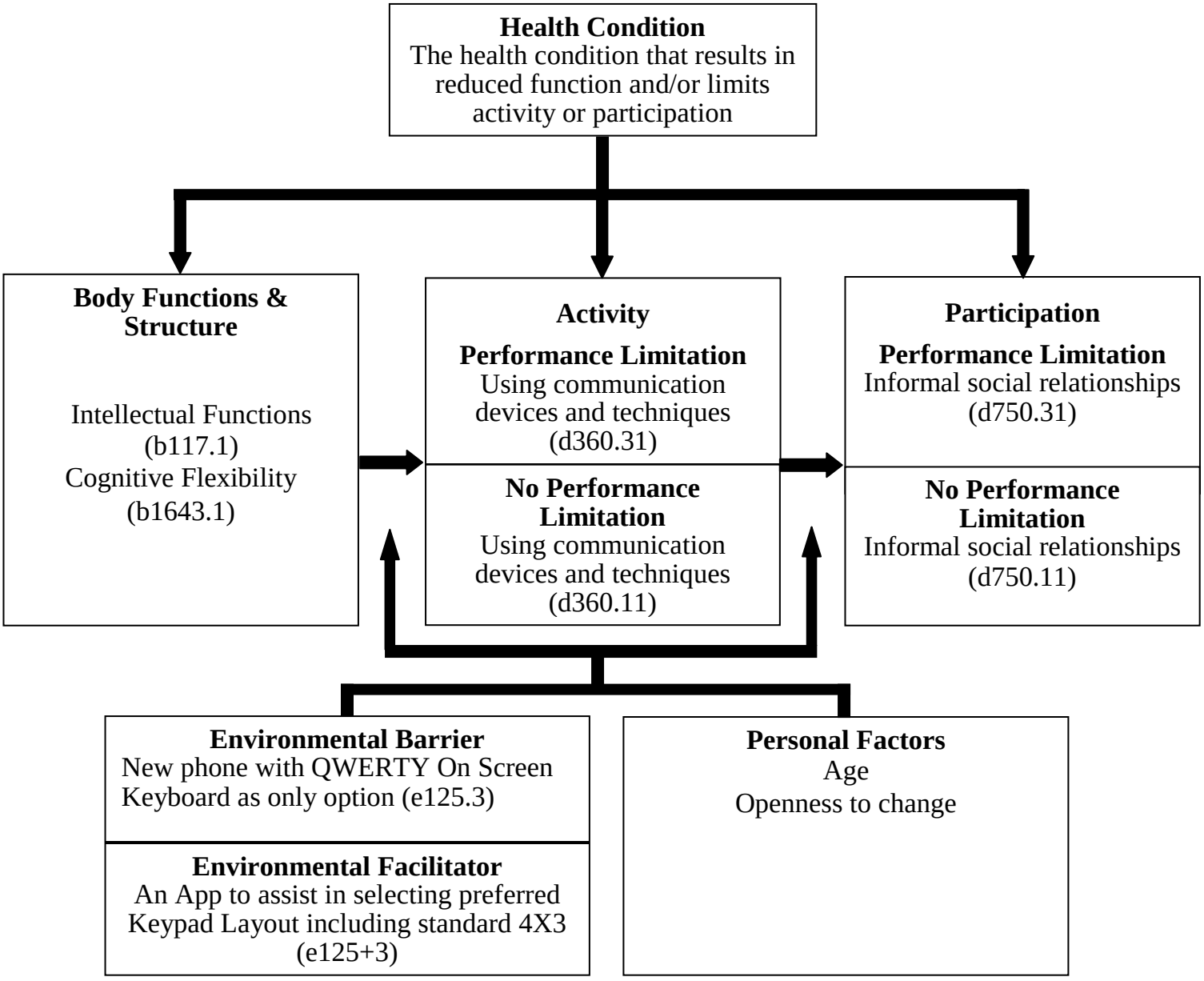

The table below illustrates the way in which using the ICF to specify the three PAE components and their interaction can assist in the definition of potential environmental barriers and the identification of design factors that can facilitate accessibility and usability.

**ICT Device** **Mobile Phone**
**Task or Goal:** **Sending a text message**
**Operational Component:** **Using the keypad**

| PAE Variable | ICF Domains | Source of Terms | Descriptive Terms | Code |
|---|---|---|---|---|
| Activity | Activities (Tasks) | ICF | Solving problems | d175 |
| | | | Using Communication devices and techniques | d360 |
| | | | Grasping | d4401 |
| | | | Manipulating | d4402 |
| | | Non-ICF | * | |
| Person | Body Functions | ICF | Intellectual Functions | b117 |
| | | | Cognitive Flexibility | b1643 |
| | | | Mobility of Joint Functions | b710 |
| | | | Stability of Joint Functions | b715 |
| | | | Control of Voluntary Movement Functions | b760 |
| | | Non-ICF | * | |
| | Body Structures | ICF | Structure of the Brain | s110 |
| | | | Structure of the Hand | s7302 |
| | | Non-ICF | * | |
| | Personal Factors | ICF | Age<br>Openness to change | pf |
| Environment | Environmental Barriers | ISO/IEC TR22411 | Inflexible keypad format options | 8.2 |
| | | | Small keypad size | 8.3.3 & 8.6 |
| | | | Touch sensitivity not adaptable | 8.2.3.2 |
| | Environmental Facilitators (Universal Design Factors) | ISO/IEC TR22411 | An App to assist in selecting preferred Keypad Layout including standard 4X3 - Alternative formats | 8.2 |
| | | | Adjustable keypad size format – Layout & Size and style of font and symbols | 8.3.3 & 8.6 |
| | | | Adjustable touch sensitivity - Tactile Information | 8.2.3.2 |

*Not considered relevant to this example

For illustration purposes the diagram below uses the ICF framework to represent the way in which the absence of an App to select a preferred on-screen keyboard display can act as a barrier to a person with mild intellectual impairment, who is skilled in using the standard 4 X 3 telephone keypad array, to send text messages with a new phone using a QWERTY display. The ICF has a system of qualifying scales (values are shown as suffixes separated from the code by a decimal point or plus sign) that are explained in the Appendix.



- The Health Condition box at the top of the figure indicates the health condition that is impacting on Body Functions, Structures, Activity or Participation. This is not coded in the ICF but is classified using the International Classification Diseases 10th Edition (ICD 10). In this example, cognitive inflexibility can arise from a number of conditions including Aspergers Syndrome, Downs Syndrome or other Intellectual Impairment.
- The Body Functions and Structures relevant to adapting from a routine to a novel situation are specified in the box on the left hand side of the diagram. In this example, the person has a mild impairment of Intellectual function (b117.1) and Cognitive flexibility (b1643.1) relating to the structure of the brain indicated by the qualifier XXX**.1**.
- The central box lists the Activity involved in using a mobile phone - Using communication devices and techniques (d360).
    - The top part of the box indicates the limitation. The first qualifier XXX**.3_** indicates that the person is experiencing a severe limitation in the performance of using the communication device (see environmental barrier box) and the second qualifier XXX**._1** indicates that she would experience a mild limitation based on her inherent or intrinsic attributes (d360.31).
    - The bottom part of the box indicates that the person has a mild difficulty in performing the activity which is in line with her capacity indicated by the performance and capacity qualifiers XXX**.11**.
- The right hand box lists the type of involvement in life situation - Participation that is impacted.
    - The top part of the box indicates the limitation in participation. The person has a severe limitation in participating in Informal social relationships (d750.31) indicated by the first qualifier XXX**.3_**, although based on her inherent or intrinsic attributes she would have a mild difficulty doing so represented by the capacity qualifier XXX**._1**.
    - The bottom part of the box indicates that the person has a mild difficulty in participating in informal social relationships (d750.11) which is in line with her capacity indicated by the performance and capacity qualifiers XXX**.11**.
- The Environmental Factor is listed in the left hand lower box.
    - In the upper part of the box – the new phone with QWERTY On Screen Keyboard as the only option is indicated as a substantial environmental barrier for the person by the qualifier XXX**.3**, i.e. Products and technology for communication (e125.3).

    - In the bottom part of the box, an App for selecting a preferred keypad layout including standard 4X3 is indicated by the qualifier XXX**+3** as a substantial facilitator (e125+3).

- The lower right hand box indicates that the Personal Factors age and openness to change can also affect the person's activity and participation in this example.

# Appendix A

## A brief overview to the International Classification of Functioning, Disability and Health (ICF)

The ICF characterises disability as the result of an interaction between an individual and the environment across the lifespan using a language and terminology which is positive. It is often referred to as a universal classification of disability in that it is as relevant to a person who needs spectacles to read as it is to someone who is unable to see anything at all. It incorporates both medical and social aspects of disability and is independent of causality so that reduced functioning is treated the same whether due to birth, trauma or ageing. It can document the impact of context (i.e. the physical and psychosocial environment) on people experiencing reduced functioning across cultures and national boundaries.

The domains contained in the ICF are described from the perspectives of Body Functions and Structures; Activities and Participation and Environmental factors that intervene to enable or disable a person. In this way, it can represent useful profiles of an individual's functioning, disability and health in various domains and document the environmental barriers or facilitators. In the ICF disability and functioning are viewed as outcomes of interactions between health conditions and contextual factors (i.e. environmental and personal factors).

The definition and the prefix used to denote each component are presented below (WHO 2001, p10)[5].

- **Body functions** (prefix 'b') are the physiological functions of body systems (including psychological functions).
- **Body structures** (prefix 's') are anatomical parts of the body such as organs, limbs and their components. Impairments are problems in body function or structure such as a significant deviation or loss.
- **Activity** (prefix 'd') is the execution of a task or action by an individual.
- **Activity limitations** are difficulties an individual may have in executing activities.
- **Participation** (prefix 'd') is involvement in a life situation.

[5] International Classification of Functioning, Disability and Health (ICF): WHO – FIC Information Sheet September 2010. Available at:

http://www.ifhima.org/docs/ICF%20%20Information%20sheet%2029112010.pdf

- **Participation restrictions** are problems an individual may experience in involvement in life situations.
- **Environmental factors** (prefix 'e') make up the physical, social and attitudinal environment in which people live and conduct their lives.

*Personal factors* refer to attributes of the person which are not related to functioning or disability such as age, gender or height. These are not coded in the ICF

Each ICF term is encoded using the appropriate component letter followed by a numeric code (e.g. Seeing Functions are coded as b210, Visual Acuity Functions as b2100 and Binocular Acuity of Distant Vision as b21000). The ICF codes are only complete with the presence of a qualifier. *Qualifiers record the presence and severity of a problem in functioning at the body, person and societal levels* (WHO 2001, p11).[6]

**ICF Qualifiers (Suffixes)**

A 5 point qualifier scale is used by the ICF for Body Function and Body Structures to indicate the extent of limitation, where 0 means no problem and 4 means a complete problem (e.g. a severe impairment of Visual Acuity is indicated as b2100.3) (see Table A1.1). It appears following a decimal point after the code.

**Table A1.1: The primary qualifiers for the domains of body function and structure**

| **ICF Domain** | **Impairment Qualifiers** | | | | |
|---|---|---|---|---|---|
| 'b' Codes | None | Mild | Moderate | Severe | Complete |
| Body Function | bXXX.0 | bXXX.1 | bXXX.2 | bXXX.3 | bXXX.4 |
| 's'Codes | None | Mild | Moderate | Severe | Complete |
| Body Structure | sXXX.0 | sXXX.1 | sXXX.2 | sXXX.3 | sXXX.4 |

Two similar 5 point scales are used with Activity and Participation ('d' codes) shown by two digits following a decimal point after a code. The first digit after the decimal point indicates the level of performance of a person in his or her current environment. The second digit after the decimal point denotes his or her capacity to carry out the activity, or participate, in a standard environment with no assistance (e.g. a moderate limitation in the activity of reading which is resolved by the use of corrective lenses is denoted by d166.02). The performance and

[6] International Classification of Functioning, Disability and Health (ICF): WHO – FIC Information Sheet September 2010. Available at:

http://www.ifhima.org/docs/ICF%20%20Information%20sheet%2029112010.pdf

capacity qualifiers for Activity and Participation codes are presented in Table A1.2. The digit not shown is depicted by the letter 'y' in the table.

**Table A1.2: The primary qualifiers for the domains of Activity and Participation**

| **ICF Domain** | | **Extent of Limitation** | | | | |
|---|---|---|---|---|---|---|
| 'd'Codes | | None | Mild | Moderate | Severe | Complete |
| Activity & Participation | Performance | dXXX.0y | dXXX.1y | dXXX.2y | dXXX.3y | dXXX.4y |
| | Capacity | dXXX.y0 | dXXX.y1 | dXXX.y2 | dXXX.y3 | dXXX.y4 |

ICF Environmental factors are qualified by two 5 point scales, each of which is denoted by the way in which it is linked to the code. One scale denotes that the factor is a barrier. The other scale indicates that it is a facilitator (e.g. the fact that corrective lenses are a complete facilitator can be denoted by e150+4 - General products and technology for personal use in daily living and poor lighting which is a substantial barrier to reading by e2401.3 - Light quality). These are presented in Table A1.3.

**Table A1.3: The primary qualifiers for the domain of Environmental Factors**

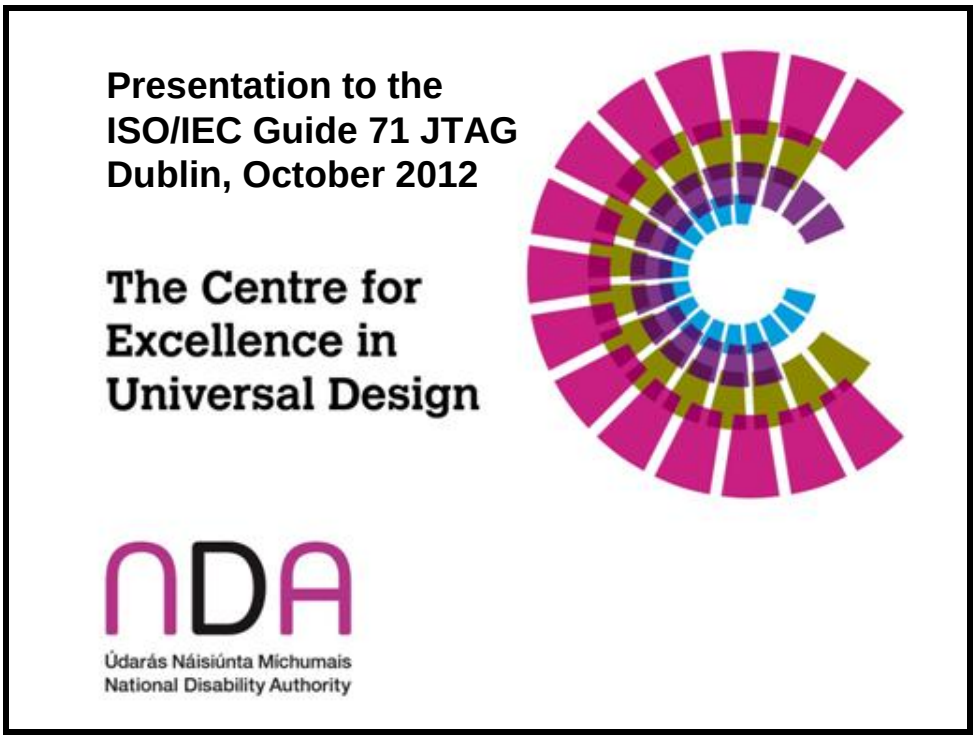
| **ICF Domain** | | **Extent of Barrier or Facilitator** | | | | |
|---|---|---|---|---|---|---|
| 'e' Codes | | | | | | |
| Environment | Barrier | None | Mild | Moderate | Substantial | Complete |
| | | eXXX.0 | eXXX.1 | eXXX.2 | eXXX.3 | eXXX.4 |
| | Facilitator | None | Mild | Moderate | Substantial | Complete |
| | | eXXX+0 | eXXX+1 | eXXX+2 | eXXX+3 | eXXX+4 |

While the ICF covers many of the characteristics of the Person, Activity and the Environment, there are areas in which it needs to be augmented. There is no single source that encodes personal factors in a systematic way and so this requires the designer to generate relevant characteristics such as age, gender or stature. Related resources may also be required to describe more detailed environmental factors such as design factors. [7]

[7] Systematized Nomenclature of Medicine--Clinical Terms (SNOMED-CT) Available at: http://www.ihtsdo.org/snomed-ct/

## Appendix B

## Presentation to the ISO/IEC Guide 71 JTAG Dublin, October 2012




## Background of the Researchers

Dr. John Gilligan, Lecturer in Computer Science.

- Knowledge Representation using ICF,
- Universal Design,
- Formal Systems Specification and Design,
- Intelligent Software Design Development,
- Assistive Technology.

Dr. Donal McAnaney, Senior Research Consultant, WRC

- 20 years experience in the application of ICIDH and ICF in the domains of education, employment and social inclusion,
- Lecturer in Inclusive Education and Rehabilitation,
- Extensive international research experience using the ICF in the fields of active inclusion, social protection and health promotion.

NDA

Universal Design

## Project Deliverables

A systematic review of international literature on the integration of the ICF and related resources into non-medical systems and domains

- Where have they been integrated?
- Why have they been integrated?
- How have they impacted on development, usability and effectiveness?

NDA

Universal Design

## Project Deliverables contd.

- Recommendations, based on best practice, on the application of terminology and classifications to optimise UD guidance standards in terms of:
  - Human Activities
  - Personal Characteristics
  - Environmental Considerations
- A guidance document with four examples – buildings, services, product and ICT

NDA

Universal Design

## Why the ICF was the Focus of the Project? contd.

**Towards a Common Language for Functioning, Disability and Health: ICF (WHO, 2001)**

Clearly specifies amongst the intended ICF Applications:

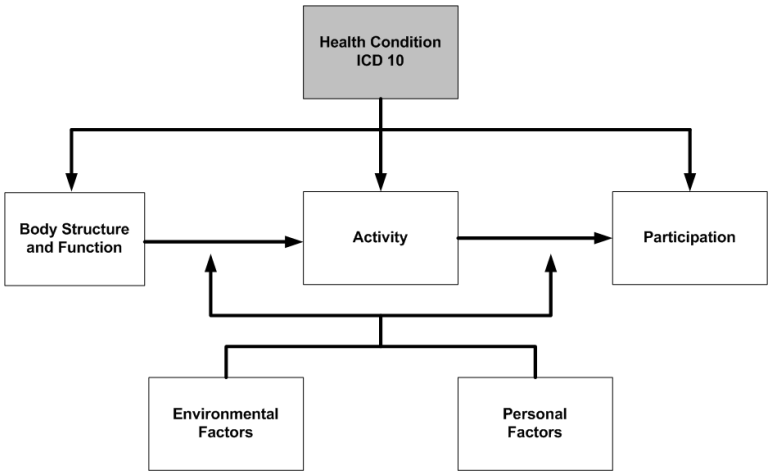
"… environmental assessment for universal design, implementation of mandated accessibility, identification of environmental facilitators and barriers, and changes to social policy" (p. 6)

http://www.who.int/classifications/icf/training/icfbeginnersguide.pdf

NDA

Universal Design

## A Brief Overview of the ICF




NDA

Universal Design

## Documenting the Impact of Guide 71 Design Factor 8.18 using ICF Codes and Qualifiers (Person with moderate limitations)

| Walking in a Public Building | | |
|---|---|---|
| **Activity**<br>**dxxx.yy** | | • Walking (d450)<br>• Moving around in different locations (d460) |
| **Person**<br>**bxxx.y**<br>**sxxx.y** | Has a moderate **Impairment** of joint mobility | • Joint mobility (b710.2)<br>• Structure of the lower extremity (s750.2) |
| | A mild limitation in **Capacity** to walk and moving around (in a standard environment) | • Walking (d450.y1)<br>• Moving around in different locations (d460.y1) |
| **Environment**<br>**exxx.y**<br>**exxx+y** | A building with a slippery surface can be a substantial **Environmental Barrier** | • Design, construction and building products and technology of buildings for public use (e150.3) |
| **Impact** | A severe limitation in the **Performance** of walking and moving around | • Walking (d450.31)<br>• Moving around in different locations (d460.31) |
| | | |
| **Environment**<br>**exxx.y**<br>**exxx+y** | A building using Guide 71 [Surface Finish 8.18] can be a complete **Environmental Facilitator** | • Design, construction and building products and technology of buildings for public use (e150+4) |
| **Impact** | **Performance** is completely facilitated | • Walking (d450.01)<br>• Moving around in different locations (d4601.01) |

NDA

Universal Design

## Applications of the ICF in the Field of Design

- Linking ISO 9999 on Assistive Technology to the ICF.
- Linking Guide 71 Human Abilities to ICF (N62)
- Concept specification in the design of:
  - Education (e.g. Swiss National Framework)
  - Emergency services,
  - Architectural products,
  - ICT applications and Computer games,
  - Household products.

NDA

Information Sheet 2 N101

Universal Design

## Key Related Resources Identified by the Review

- The Systematized Nomenclature of Medicine - Clinical Terms (SNOMED-CT)
- Assessment of Motor Process Skills (AMPS)
- Handbook for Analyzing Jobs (HAJ)
- Inclusive Design
- 'Design of Everyday Life'
- Matching Person and Technology (MPT)

NDA

Universal Design

## Recommendations arising from the International Review

- An approach should be created for integrating appropriate ICF codes into existing design guidance definitions and concepts and to inform future design guidance standards development.
- Appropriate related resources should be used in conjunction with the ICF to provide a systematic, clearly specified and linguistically consistent framework and terminology to enhance design guidance standards.

NDA

Universal Design

## Recommendations arising from the International Review contd.

- The use of the ICF in developing design guidance standards needs to be augmented in terms of the specification of:
  - Personal factors;
  - Environmental factors;
  - Person-task and person-object interactions;
  - Anthropometric characteristics.

NDA

Universal Design

## Recommendations arising from the International Review contd.

- Linking rules, such as those developed by Cieza et al (2005), should be used to identify appropriate equivalences between current terms and the codes and definitions of the ICF.
- Consideration should be given to the production of a short list of the ICF codes which are most relevant to the domain of design guidance standards.

NDA

Universal Design

## A Selection of ISO/IEC Terms Referring to ICF (Seeing Functions) b210

| | |
|---|---|
| **Visual Abilities** | **ISO -20282-1:2006(7.3.4):** Ease of operation of everyday products — Part 1: Design requirements for context of use and user characteristics; |
| | **ISO 26800:2011(E) (Annex B):** Ergonomics — General approach, principles and concepts; |
| **Sight** | **ISO 21542:2011(B.3.1):** Building construction -- Accessibility and usability of the built environment; |
| **Seeing** | **ISO/IEC Guide 71:2001(9.2.1):** Guidelines for standards developers to address the needs of older persons and persons with disabilities; |
| **Sight Skills** | **IEC/TR 62678:** Audio, video and multimedia systems and equipment activities and considerations related to accessibility and usability; |
| **Low Vision** | **ISO/IEC 24751-3:2008(E):** Information technology — Individualized adaptability and accessibility in learning, education and training - Part 3: Access for all digital resource description Technologies. |

NDA

Information Sheet 2 N101

Universal Design

## Key ICF Linking Rules

1. A prerequisite for accurate and appropriate linking is a good working knowledge of the ICF.
2. A term and its related concept should be linked to the most precise ICF category.
3. Where no corresponding ICF code is found do not use the so-called “other specified” ICF categories but document the additional information.

Cieza (2005)

NDA

Information Sheet 2 N101

Universal Design

## Key ICF Linking Rules contd.

9. The original domain term and the matching ICF code(s) should be recorded together in the resultant documentation produced by the mapping process.

The terms recorded should include:

<Source Term > Source Reference & (ICF Term) ICF-Code:

<Balance > 9.2.5 & (Vestibular Functions) b235:

12. When the ICF cannot provide an appropriate code, alternates from other sources should be sought.

NDA

Information Sheet 2 N101

Universal Design

## Example of Application of the Linking Rules to mapping the ICF to Guide 71 (2001) Human Abilities

| Person | | | |
|---|---|---|---|
| G71 <Seeing> 9.2.1 | & | ICF (Seeing Functions) b210: | |
| G71<Dexterity> 9.3.1<br>G71<Manipulation> 9.3.1 | & | ICF (Mobility of Joint Functions) b710 | & |
| | | ICF (Mobility of Bone Functions) b720 | & |
| | | ICF (Muscle Power Functions) b730: | |
| G71<Respiratory Allergies> 9.5.4 | & | ICF (Immunological System Functions) b435 | & |
| | | ICF (Respiration Functions) b440 | & |
| | | ICF (Respiratory Muscles Functions) b445: | |

NDA

Information Sheet 2 N101

Universal Design

## Linking ICF and Related Resources to Activity and the Environment

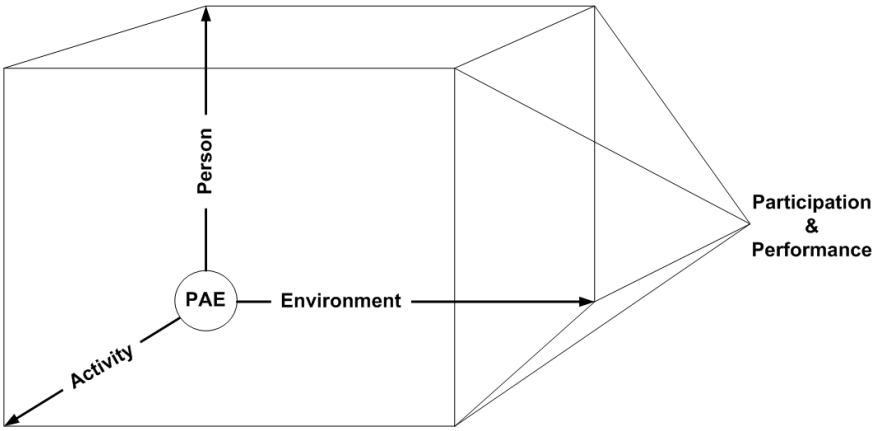
| Activity | | | |
|---|---|---|---|
| <Shopping with a Credit Card> | & | ICF (Shopping) d2600 | & |
| | | SMOMED-CT [Using a Credit Card] Code: 441830018, Concept: 300709005: | |
| **Environment** | | | |
| <Well lit reception room> | & | ICF (Light quality in a space) e2401 | & |
| | | SNOMED-CT [Reception room] Code: 224690008: | |

NDA

Information Sheet 2 N101

Universal Design

## The interrelationship of Person, Activity and Environment (PAE) in standards development




NDA

Universal Design

## Main Conclusion

The ICF can transform and systematise the representation of the key components of Person, Activity and Environment (PAE) in standards development

NDA

Universal Design

# References

[1] ISO 26800:2011 Ergonomics - General approach, principles and concepts, Available at: http://www.iso.org/iso/home/store/catalogue_tc/catalogue_detail.htm?csnumber=42885

[2] International Classification of Functioning, Disability and Health (ICF): WHO – FIC Information Sheet September 2010. Available at: http://www.ifhima.org/docs/ICF%20%20Information%20sheet%2029112010.pdf

[3] ISO/IEC Guide 71:2001 - Guidelines for standards developers to address the needs of older persons and persons with disabilities, Available at: http://www.iso.org/iso/catalogue_detail?csnumber=33987

[4] Cerniauskaite M, Quintas R, Boldt C, Raggi, A, Cieza, A, Bickenbach, J.E. & Leonardi, M. (2011). Systematic literature review on ICF from 2001 to 2009: its use, implementation and operationalisation, *Disability and Rehabilitation,* 33(4):281-309

[5] WHO (2001). *Towards a Common Language for Functioning, Disability and Health: ICF*, World Health Organisation, Geneva, http://www.who.int/classifications/icf/training/icfbeginnersguide.pdf

[6] WHO (2001). Annex 8 - Future Directions for the ICF, *International Classification of Functioning, Disability and Health :ICF*, pp251 World Health Organisation, Geneva

[7] WHO (2011) *World Report on Disability*, WHO Press, Geneva. Available at: http://www.who.int/disabilities/world_report/2011/en/index.html

[8] For a more detailed description of the work of the UN Washington Group on Disability Statistics see http://unstats.un.org/unsd/methods/citygroup/washington.htm

[9] O'Donovan, M. (2011). *Issue 5: Measure of Activity and Participation (MAP): Disability data sources in Ireland*, Health Research Board, Dublin Available at: http://www.hrb.ie/index.php?id=1010&tx_hrbpublications_pi1%5BshowUid%5D=544

[10] ICF Research Branch, Available at: http://www.icf-research-branch.org/

[11] Steinfeld, E. & Danford, S. (2006). *Universal Design and the ICF*, IDEA Center, State University of New York at Buffalo, SUNY

[12] Bauer, S.M. & Arthanat, S. (2010). SBIR and STTR Programs for Assistive Technology Device Development: evaluation of impact using an ICF-based classification, *Assistive Technology Outcomes and Benefits*, 6(1):39-72

[13] Guide 71 - Task Force 4 (2012). ISO-IECJTAG_N0062 Reports from the Task Forces - July

[14] Virtual User Modeling and Simulation Cluster, Available at: http://www.veritas-project.eu/vums/

[15] Gilligan, J. & Smith, P. (2011). Adapting Linking Rules to the International Classification of Functioning as a method for Representing Assistive Technology Knowledge, In *Everyday Technology for Independence and Care AAATE,* pp1155-1160 Maastricht IOS Press

[16] Francescutti, C, Frattura, L., Troiano, R., Gongolo, F., Martinuzzi, A., Sala, M., Meucci, P., Raggi, A., Russo, E., Buffoni, M., Gorini, G., Conclave, M., Petrangeli, A., Solipaca, A., & Leonardi, M. (2009). Towards a common disability assessment framework: theoretical and methodological issues for providing public services and benefits using ICF, *Disability and Rehabilitation,* 31: Supplement 1:S8-S15

[17] Gilligan, J. & Smith, P. (2011). Adapting Linking Rules to the International Classification of Functioning as a method for Representing Assistive Technology Knowledge, In *Everyday Technology for Independence and Care AAATE,* pp1155-1160 Maastricht IOS Press

[18] Fisher, A. G. (2006). *Assessment of Motor and Process Skills. Vol. 1: Development, Standardization, and Administration Manual* (6th ed.) Fort Collins, CO: Three Star Press

[19] Bickenbach J, Cieza A, Rauch A, Stucki G (eds) (2012). *ICF Core Set Manual for Clinical Practice,* Hogrefe, Göttingen, Available at: http://www.icf-research-branch.org/icf-core-sets-projects/130-icf-core-set-manual-for-clinical-practice/447-icf-core-sets-manual-for-clinical-practice.html

[20] ICF Research Branch, Available at: http://www.icf-research-branch.org/

[21] European Platform for Rehabilitation: Benchmarking group on ICF, Helsinki, 2010 http://www.epr.eu/images/EPR/documents/CAPS/2010/ICF%20benchmarking%20group/icf-benchmarkinggroup-programme-final.pdf

[22] Promoting and Protecting Mental Health – Supporting Policy through Integration of Research, Current Approaches and Practices, Available at: http://www.mentalhealthpromotion.net/?i=promenpol

[23] Queirós, A., Silva, A.G., Alvarelhão, J., Teixeira, A. & da Rocha N.P. (2012). Ambient Assisted Living Technologies, Systems and Services: A Systematic Literature Review, *Proceedings AAL Conference*, Algarve, Portugal

[24] Sanford, J. & Bruce, C. (2010). Measuring the Physical Environment. In T. Oakland and E. Mpofu (Eds.). *Rehabilitation and Health Assessment: Applying ICF guidelines,* pp207-228, New York, NY: Springer

[25] http://www.snomed.org

[26] http://www.hhs.gov/healthit/chiinitiative.html

[27] http://www.cpic.org.uk/en/publications/uniclass-listing.cfm

[28] http://www.omniclass.org

[29] Cieza A., Geyh S. Chatterji S,Kostanjsek N.,Ustun B., Stucki G. (2005). ICF Linking rules an update based on lessons learned, *J Rehabil Med* 37:212–218

[30] World Health Organization [WHO] (2011). International Classification of Functioning, Disability and Health (ICF) Online Browser, Available from http://www.who.int/classifications/icf/browser/

[31] Fisher, A. G. (2006). *Assessment of Motor and Process Skills. Vol. 1: Development, Standardization, and Administration Manual* (6th ed.) Fort Collins, CO: Three Star Press

[32] Sanford, J. & Bruce, C. (2010). Measuring the Physical Environment. In T. Oakland and E. Mpofu (Eds.). *Rehabilitation and Health Assessment: Applying ICF guidelines*, pp207-228, New York, NY: Springer

[33] WHO (2001)*Towards a Common Language for Functioning, Disability and Health: ICF*, World Health Organisation, Geneva, http://www.who.int/classifications/icf/training/icfbeginnersguide.pdf

[34] WHO (2001)*Towards a Common Language for Functioning, Disability and Health: ICF*, World Health Organisation, Geneva, http://www.who.int/classifications/icf/training/icfbeginnersguide.pdf

[35] Systematized Nomenclature of Medicine--Clinical Terms (SNOMED-CT) http://www.ihtsdo.org/snomed-ct/

[36] Cieza A, Brockow T, Ewert T, Amman E, Kollerits B, Chatterji S, et al (2002). Linking health-status measurements to the international classification of functioning, disability and health, *J Rehabil Med* 34:205-210

[37] Cieza A., Geyh S. Chatterji S,Kostanjsek N.,Ustun B., Stucki G. (2005). ICF Linking rules an update based on lessons learned, *J Rehabil Med* 37:212–218

[38] Oltman R, Neises G, ScheibleD, Mehrtens G and Grüneberg C. (2008). ICF components of corresponding outcome measures in flexortendon rehabilitation – a systematic review, *BMC Musculoskeletal Disorders*, 9:139; doi:10.1186/1471-2474-9-139 Available from: http://www.biomedcentral.com/1471-2474/9/139

[39] Reed, G. M., Lux, J. B., Bufka, L. F., Trask, C., Peterson, D. B., Stark, S., et al (2005). Operationalizing the International Classification of Functioning, Disability and Health in clinical settings, *Rehabilitation Psychology* 50:122–131

[40] http://www.ihtsdo.org/snomed-ct/

[41] OmniClass [tm] A Strategy for Classifying the Built Environment, Table 13 – Spaces by Function, US National Standard - 2012-05-16 p43; Available from: http://www.omniclass.org/

[42] http://www.cpic.org.uk/en/publications/uniclass-listing.cfm

[43] Geyh, S., Peter, C., Müller, R., Bickenbach, J.E., Kostanjsek, N., Üstün, B.T., Stucki, G., and Cieza, A. (2011). The Personal Factors of the International Classification of Functioning, Disability and Health in the literature - a systematic review and content analysis, *Disability and Rehabilitation*, 33(13-14):1089-1102

[44] Reed, G. M., Lux, J. B., Bufka, L. F., Trask, C., Peterson, D. B., Stark, S., et al (2005). Operationalizing the International Classification of Functioning, Disability and Health in clinical settings, *Rehabilitation Psychology*, 50:122–131

[45] Gilligan, J. & Smith, P. (2011). Adapting Linking Rules to the International Classification of Functioning as a method for Representing Assistive Technology Knowledge, In *Everyday Technology for Independence and Care AAATE*, pp1155-1160 Maastricht IOS Press