Integrating the ICF and Related Resources to Improve Universal Design Guidance Standards

Systematic Review of International Literature: Integration of WHO-ICF and Related Resources into Non-medical Systems and Domains

Prepared for

Centre for Excellence in Universal Design

National Disability Authority

25 Clyde Road

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Section 1: Introduction and explanation of terms of reference

Universal Design guidance standards and related design guides are currently under discussion and review. One aspect that is central to this discussion is the way in which human abilities and their interaction with the environment can be more systematically classified and defined. An exploration of current and potential classification systems for human activities and characteristics as well as environmental factors can make a positive contribution to support the development of Universal Design Guidance Standards.

This report examines the how the International Classification of Functioning, Disability and Health (ICF) and other major approaches have been applied to characterising human environment interactions. It does so in order to identify the most useful of these in the light of their uses and applications in a range of areas with a specific focus on applications within non-medical (or perhaps more accurately non-clinical) settings. Such settings include the design of objects, services or processes.

Universal Design is a very broad concept and it has a wide range of potential applications. Classification systems that support such a broad concept and approach would also ideally have a broad basis, even if there is not a one to one correspondence between the two.

Few such broad based systems exist, with perhaps only the WHO's ICF approaching this. The challenge therefore becomes one of identifying a soundly based system and augmenting it with additional elements (related resources) in order to ensure that it meets the full requirements for producing design guides to support Universal Design.

This report examines the international literature in this area with specific reference to the ICF. The ICF is the most systematic and widely supported classification system available and is therefore a major potential candidate from which to generate design guides. However, it is a system that needs further development and this report places requirements on these development needs as well as suggesting ways and means (through related resources) of overcoming gaps in its current construction. The report also examines some other systems which may be useful in the current context.

The review describes a number non-medical systems and domains in which the ICF has been applied and explores the relationship between the classification and related resources, which aim to systematically describe human functioning within an environmental context. It also discusses the rationale underpinning the use of the ICF and appraises the impact of this approach in each of the non-medical systems and domains reviewed. The report also makes explicit recommendations on how best to proceed in relation to applying human activities, characteristics and

environmental factor terminology and classifications to optimise Universal Design guidance standards.

The research will also inform a separate guidance document that will demonstrate how to apply the optimal terminology and classifications from the ICF and related resources to improve a new revision of Guide 71. It will include examples of its application to the areas of the built environment, products, services, and information and communication technologies. The report concludes with an outline presentation of the guidance document that will conclude the research.

Section 2 of this review presents the approach to the study and describes the main components of the ICF. Section 3 presents the main body of the review. It is divided into four main sub-sections, the first of which addresses initiatives which have integrated the ICF into non-medical systems and domains. The second sub-section describes the way in which related resources have being used to address the same or similar objectives. The third sub-section discusses the rationale underpinning the integration of the ICF and related resources into non-medical systems domains and the final sub-section considers the impact of the ICF on these systems and domains in terms of usability and effectiveness. Section 4 presents the conclusions and recommendations for the field of Universal Design and the development of design guides.

Section 2: Approach and Methodology

There is a growing acceptance of the value of paradigms of design inclusion, such as Universal Design (UD) which has important for product and environmental design and also for service delivery. This review examines the extent to which the ICF and related resources can be applied to enhance the principles of UD.

The approach adopted for the review did not pre-suppose that the ICF represented best practice in classifying human abilities and environmental factors. In fact, previous work carried had identified a number of gaps and constraints inherent in the current version of the ICF. For example, the way in which the ICF describes dexterity is lacking in some essential details. Further, the fact that it does not classify personal factors means that a number of human characteristics relevant to design are not covered by the classification.

The scope was broader than simply ICF based approaches. It involved the identification of all initiatives that set out to link the environment with the person including all fields that are related to the accessibility and usability of products, technologies, settings, services, equipment and the physical environment. This was followed by an in-depth analysis and evaluation to identify the most relevant models and approaches. The initial focus of the literature review was upon documenting all current approaches to describing the link between the person and the environment.

The ICF is a multi-purpose classification system, developed by the World Health Organisation (WHO), in consultation with international disability representative organisations and published in 2001. It is intended for a wide range of uses including environmental assessment for Universal Design, the implementation of mandated accessibility and the identification of environmental facilitators and barriers. One central function of the ICF is to provide a common language to improve communication across countries, disciplines, services and time.

The ICF views disability as arising from 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 model of disability in that it is equally relevant to a person who needs spectacles and to someone who is unable to see at all. It incorporates both medical and social aspects of disability and is independent of aetiological 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.

One aim of ISO/EC Guide 71 is to outline the relationship between the requirements of standards and the accessibility and usability of products and services. It aims to create a consistent approach across international boundaries. It is targeted at the authors of International Standards and provides them with the

requisite knowledge and approaches to take into account the needs of older persons and persons with disabilities. It aims to provide standards writers with information and insight into the ways in which human abilities can interact with products, services and environments in terms of usability. The Guide also provides an outline of the relationship between the requirements in standards and the accessibility and usability of products and services and addresses the advantages of adopting accessible design principles.

It acknowledges the importance of the accessibility and usability of every day products and services in addressing the needs of persons with reduced functioning across the lifespan and links the interaction between a person and products and services to outcomes. It makes a distinction between assistive devices and products and services for general use.

Since Guide 71 was developed, there have been many changes that impact on its relevance and usage. These include technological changes e.g. innovations such as smart phones, tablet computers and digital TV; innovations in standards and design e.g. the Web Content Accessibility Guidelines 2.0 (2008); and new policy and legislative initiatives including the transposition of the UN Convention on the Rights of Persons with Disabilities (UNCRPD) and the introduction of legislation combating discrimination on a number of grounds including age and disability in most countries.

The International Classification of Functioning and its Components

While the overall aim of the ICF is stated as providing a unified and standard language and framework for the description of health and health-related states, the framework and classification has a wider application to spheres such as education and employment. [1] The ICF has had a major impact to date - 191 countries have signed it into being and it is being used in many different applications, across countries all over the world, including Australia, China, USA, and Japan. [2]

At national level, ICF based data sets and questionnaires are currently used in a number of countries including Australia, Ireland, Mexico, Zimbabwe and Malawi. Several countries have started the process of streamlining ICF into their health & social information standards and legislation. The development and piloting of ICF based indicators and reporting systems for use in rehabilitation, home care, elder care and disability evaluation are ongoing in Australia, Canada, Italy, India, Japan, and Mexico. It is used to classify interventions and outcomes for many diverse groups of people.[3] Major policy makers such as the American Occupational Therapy Association have formally adopted it for use.[4] The impact of the ICF is significant.

As a classification, the ICF brings together different domains which can be applied systematically to specify the status of a person with reduced function in terms of activity and participation in life activities. Functioning is an umbrella term

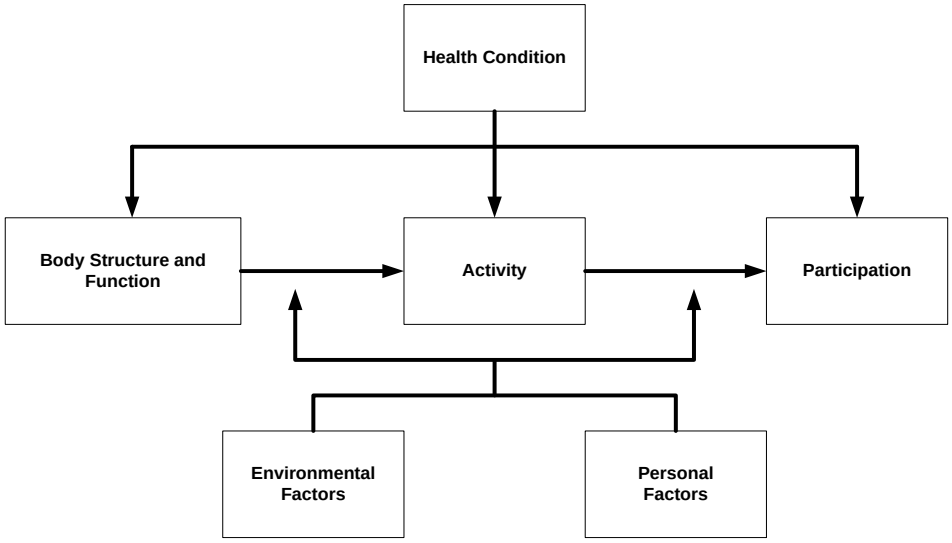
encompassing all body functions, activities and participation. Disability is considered to be the result of an interaction between a person with impaired function and contextual factors.

The domains contained in the ICF are described from the perspective of the body, the individual and society in two lists - Body Functions and Structures and Activities and Participation. It also lists environmental factors that interact with all these constructs to enable or disable a person. In this way, it allows profiling of an individual's functioning, disability and health in various domains and document the environmental barriers or facilitators for that person.

The components of the ICF are presented in Figure 1 below.

Body functions are the physiological functions of body systems (including psychological functions). Body structures 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.

Figure 1 Components of the International Classification of Functioning



Activity is the execution of a task or action by an individual. Participation is involvement in a life situation. Activity limitations are difficulties an individual may have in executing activities. Participation restrictions are problems an individual may experience in involvement in life situations. For example, the production of the voice and mental functions of language are classified as functions, communicating using language is an activity and holding a conversation with another person can be considered participation. Environmental factors make up the physical, social and attitudinal environment in which people live and conduct their lives.

The ICF has an alphanumeric system where letters are used to denote each component. Body Functions are prefixed with the letter 'b', Body Structures with 's', Activities and Participation with 'd', and Environmental Factors with 'e'.

These are followed by a numeric code that starts with the chapter number (one digit), followed by the second level (two digits), and the third and fourth levels (one digit each). The ICF codes are only complete with the presence of a qualifier, which denotes a magnitude of the severity of the problem. Qualifiers are coded using one, two or more numbers after a point (or separator). Use of any code should be accompanied by at least one qualifier. Without qualifiers, codes have no inherent meaning. All Body Functions and Structures, Activities and Participation components, are quantified using the same generic scale – see Table 1. Having a problem may mean an impairment, limitation, restriction or barrier depending on the construct.

Table 1: The qualifier scale used by the ICF for Body Function, Body Structures and Activity and Participation

NO problem (none, absent, negligible,…) 0-4 %	xxx.**0**
MILD problem (slight, low,…) 5-24 %	xxx.**1**
MODERATE problem (medium, fair,...) 25-49 %	xxx.**2**
SEVERE problem (high, extreme, …) 50-95 %	xxx.**3**
COMPLETE problem (total,…) 96-100 %	xxx.**4**
Not specified	xxx.8
Not applicable	xxx.9

For example, a mild problem with joint mobility is coded as b710.1; a moderate problem with lower limbs is coded s750.2.

Activity and Participation codes are qualified using two qualifiers, each of which is specified using the same 0-4 scale described above.

- The **performance qualifier** indicates the extent of restriction by describing a person's actual performance of a task or action in their current environment including all aspects of the physical, social and attitudinal world. The Performance qualifier indicates the difficulty the respondent experiences in doing things, assuming that they want to do them.

- The **capacity qualifier** indicates the extent of activity limitation by describing the person's ability to execute the task or an action. The capacity qualifier refers to limitations that are inherent or intrinsic features of the person themselves without the assistance of another person, or assistance provided by an adapted or specially designed tool or vehicle, or any form of environmental modification.

For example, if a person has a severe difficulty with walking without an aid but is able to manage with a walking aid or an adapted physical environment this would be coded as d450.13 indicating that the person's performance is mildly limited but in the absence of an environmental facilitator his or her capacity to walk would be severely limited

Conversely, if the qualifiers were reversed i.e. d450.31, this would indicate that the person's performance in walking is severely limited even though his or her capacity to walk is only mildly limited. This could be the case where the floor surface is particularly slippery or where the pile of a carpet is very deep.

The ICF Environmental component includes codes relating to Products and Technology, Natural Environment and human made changes to the Environment, Support and Relationships, Attitudes, and Services systems and policies.

ICF uses two scales, each of which range from 0 to 4, to represent the impact of the environment on a person. The facilitator scale use a plus symbol (+) as a separator and the barrier scale use a point or minus symbol (- or.). These are presented in Table 2.

Table 2: ICF Environmental Qualifiers

Barrier Scale		Facilitator Scale	
NO barrier	xxx.**0**	**NO** facilitator	xxx+**0**
MILD barrier	xxx.**1**	**MILD** facilitator	xxx+**1**
MODERATE barrier	xxx.**2**	**MODERATE** facilitator	xxx.+**2**
SEVERE barrier	xxx.**3**	SUBSTAINTIAL facilitator	xxx.+**3**
COMPLETE barrier	xxx.**4**	**COMPLETE** facilitator	xxx.+**4**

For example, if a person's family assists a person with a severe limitation in shopping this would be coded as:

- d6200.13 Shopping - Mild performance difficulty with shopping but a severe capacity limitation without assistance
- e310 +3 Immediate Family – Substantial Facilitator

ICF information may be considered in two parts.

- Part 1 comprises components of Functioning and Disability and includes Body Functions and Structures in additions to the Activities and Participation component.
- Part 2 comprises components of Contextual Factors which includes a list of Environmental Factors which are organized in sequence from the individual's most immediate environment to the general environment.

One challenge facing researchers and practitioners who wish to use the ICF in applied situations is its complexity and length. The full ICF comprises of about 1400 individual codes. A range of **Core Sets** have been developed In order to make it easier for clinicians and researchers to apply the ICF. A core set is a list of selected categories from the entire classification that can serve as minimal standards in a range of contexts related to diverse heath conditions. A brief core set, which would be most relevant to research and surveys, can consist of between 10 and 30 codes, whereas a comprehensive core set for use in multidisciplinary assessments can have up to 70 or 80 codes.

Personal Factors is also a component of Contextual Factors but they are not yet classified in ICF because of the large social and cultural variance associated with them. However, work is ongoing in developing a comprehensive list of personal factors and it is expected that such a list will be included in the next publication of ICF.[5] This is discussed in more detail in a subsequent section.

Section 3: Review of International Literature

3A: Integrating the ICF into Non-medical systems

I Summary of existing surveys on the use of the ICF

There are a number of summaries available on known applications of the ICF. For example Bruyere et al (2005) carried out a major literature survey for applications of the ICF in 2005 reviewing the three year period since it was formally endorsed.[6] It categorised its finding into five broad categories.

- The meaning of the ICF and how it can be used;
- Use in specific fields, such as nursing, occupational therapy, speech–language pathology, and audiology
- The classification of particular disorders, such as chronic health conditions, neuromusculoskeletal conditions;
- Recoding prior work across multiple surveys and across country coding schemes for disability-related national survey items;
- Governmental uses of the ICF in the United States and selected countries.

In addition, Jelmsa (2009) analysed 243 ICF related papers and identified seven clearly defined categories of application: [7]

- Papers that explained or critiqued the conceptual framework of the ICF;
- Descriptions of the application of ICF concepts to either disciplinary or condition specific management or surveys of clients;
- Attempts to link the ICF to new or existing measures of functional ability;
- Identifying ICF core sets for various health conditions;
- Data collection using the ICF;
- Papers on the psychometric properties of the ICF;
- Studies not easily classified due to poor design and other factors.

The largest and most comprehensive literature review of ICF applications was published in 2011. Cerniauskaite et al (2011) categorized 672 papers through a systematic search of the EMBASE, Medline and PsychInfo electronic databases.[8] The categories that emerged reflected those outlined previously.

- The largest group (30%) of papers concerned itself with the conceptual model of the ICF;
- The next largest category looked at clinical and rehabilitation contexts (25.9%)
- This was followed by the development of ICF and ICF related instruments (15.3%);
- Linking papers (10.9%);

- A novel category which is important for this review of non-medical applications of the ICF was the non-clinical group of papers (9.2%);
- Papers where the ICF was just mentioned (7.9%).

A number of areas of the 2011 literature review are relevant to this review of non-medical applications of the ICF. Firstly, conceptual papers provide a basis for conceptualising the domains of disability and elderly people. This is important in describing the world in which inclusion initiatives are proposed. Typically these concepts form the basis and rationale of such initiatives. Secondly, the development of the ICF and ICF related instruments and the non-clinical context groups of papers provide an insight into the process of adapting and integrating ICF into domains other than those related clinical applications.

The many ICF based survey instruments are also important. These illustrate how the ICF can be used to define population characteristics in terms of needs and functioning in order to capture the implications of reduced capacity due to age or disability and to quantify social and economic impacts.

Finally, some of the major non-medical applications of the ICF described in the non-clinical group of papers in the 2011 review included papers on contexts different from health such as disability eligibility, education, employment and statistics, which are relevant to the current review.

While the 2011 systematic literature review on ICF was very comprehensive, it was by no means exhaustive. There are many other initiatives which involve the ICF, particularly in relation to the design of services and especially products, which were not covered. This review presents a number of findings in relation to these.

II. Conceptualising Disability - Research and Policy Design

The German Institute for Medical Documentation and Information (DIMDI) has developed a research resource to use multidisciplinary research to develop a better understanding of disability together with the WHO Collaborating Centre for the Family of International Classifications (WHO-FIC).[9] This ICF Research Branch hosts a website about initiatives using the ICF to develop, evaluate, and disseminate tools and models of functioning and health for different groups of people and settings. Its mission is to promote health, the restoration of functioning and the prevention of disability by applying the ICF. An important part of the ICF Research Branch is its work in the development of ICF core sets. 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 used 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. While many core sets are focused on specific health conditions, the ICF Research Branch has been involved in the developed of a core set for vocational rehabilitation, which is focused on the employment of people with disabilities and a generic core set which is a minimum list for use in all situations.

The ICF also served as a conceptual framework for 11 country studies of the status of young people with health problems or disabilities. The focus of the studies was the potential impact of an active inclusion approach, which involves the coordination of education, employment, health and social protection strategies, in informing national policies and strategies.[10]

III. Defining the Population - Designing data and information systems

The ICF has received significant consideration in the design and application of data and information systems. The complexity and multidimensionality of the concept of 'disability' creates significant measurement challenges. The diversity of measures of disability vary in terms of how and why the data are being collected, the underpinning definition of disability, the aspects being measured, the design of the questions used and methods of data collection. As a result estimates of the prevalence of disability vary widely from country to country. For example, while the incidence of disability across the EU is estimated to be 15 %, data from Eurostat illustrate the wide disparities between EU Member States based on self report of long standing health problems or disabilities ranging from a high of 32% in Finland to a low of just over 5% in Romania.[11]

The World Report on Disability acknowledged the need for data to be relevant to the national context of a country but also highlights the requirement for data to be comparable internationally.[12] The Report proposed that both of these aspirations are possible if data collection approaches are based on international standards and in particular the information-related standards provided by the ICF. It recommended using the ICF as the universal framework for disability data collection related to the policy goals of participation, inclusion and health. It suggested that countries can use the ICF to produce definitions and national data standards and make sure that data collection covers the range of ICF domains, impairments, activity limitations and participation restrictions, related health conditions and environmental factors even when using a minimal set of data items.

There are currently a number of initiatives which aim to harmonise and standardise question sets for collecting data on disability at population level including the United Nations Washington Group on Disability Statistics. [13] The UN Washington Group on Disability Statistics is an international consultation expert group established in 2001. It aims to assist in the measurement and international comparison of disability data. 77 National Statistical Offices are

participating along with seven international organizations, six Disability Representative Organisations, the UN Statistics Division, and three UN affiliated bodies.

The Washington Group has developed a set of six questions for use in censuses and surveys based in the Fundamental Principles of Official Statistics and the ICF. In combination with other census data, the questions can be used to capture data on the participation of people with disabilities in education, employment, social life as well as other domains. Each question has four types of response, which capture the range of functioning, from mild to severe: no difficulty, some difficulty, a lot of difficulty and unable to do it at all. The consensus questions are:

1. Do you have difficulty seeing, even if wearing glasses?

2. Do you have difficulty hearing, even if using a hearing aid?

3. Do you have difficulty walking or climbing steps?

4. Do you have difficulty remembering or concentrating?

5. Do you have difficulty with self-care, such as washing all over or dressing?

6. Using your usual (customary) language, do you have difficulty communicating (for example, understanding or being understood by others)?

Another example of the application of the ICF to international disability data collection is the World Health Survey (2002-2004).[14] This was a face-to-face household survey carried out in 70 countries. The conceptual framework and functioning domains of the survey were derived from the ICF.

The ICF has informed the design and development of disability data collection in Ireland. One example is the Measure of Activity and Participation (MAP) which has been integrated into the Health Research Board (HRB) National Physical and Sensory Disability Database (NPSDD).[15] The NPSDD was established in 1998 by the Department of Health (DoH) and was initiated nationally in 2002. The aim was to create a national database of information on the needs of people with physical and sensory impairments for specialised health and social services.

As a signatory to the ICF, the DOH expanded the data gathered to cover participation based on the ICF in 2004. The MAP section of the NPSDD has three elements measuring barriers and challenges experienced by respondents in accessing life activities, the degree of restriction experienced in participating in areas such as education and training, employment and social life and the WHO Disability Assessment Schedule or WHODAS 2.0 which measures difficulties with everyday tasks.[16] The HRB has published a range of MAP reports on topics such as a report correlating MAP data with the National Disability Survey (NDS); participation and ageing; the participation of people with neurological conditions; and the impact of services and supports on the participation of people with physical or sensory disabilities.

One key interpretative issue has arisen in relation to the data gathered by the NPSDD. The current data procedures collect data on diagnosis but not level of functioning. This is being redressed by a working group who are developing a Body Function Questionnaire which could complement the current data.

The ICF also influenced the design of disability questions in the 2006 Irish National Census. Two questions were included on the presence of a long-term health condition and the impact of that condition on functioning. The Central Statistics Office carried out a National Disability Survey (NDS) on a sample of those who had reported a disability and a group of people in private households who did not.[17] The NDS was based on the ICF and used a broader definition of disability than the census, with more domains, including pain and breathing, and a measure of severity.

The National Disability Authority (NDA) has been involved in a number of other initiatives using the ICF to develop disability data systems. Measuring Health and Disability in Europe (MHADIE) is an example of this.[18] MHADIE (2005-2007) was led by the WHO and aimed to test the feasibility and usefulness of the ICF as an international standard capable of influencing and supporting EU policies on health and disability.

A number of organisations involved in MHADIE continued their work under another EU funded project, the Multidisciplinary Research Network on Health and Disability in Europe (MURINET).[19] MURINET (2007-2010) explored how to use the ICF to identify needs and plan interventions for people with disabilities. It explored how to operationalise ICF for research and practical implementation in a number of settings including clinical and rehabilitative environments, child health, psychology, education, ethics and human rights. It also reviewed the practical implications of an ICF based intervention strategy designed to increase participation, by means of environmental facilitators or increased functional capacity.

IV. ICF and Eligibility Determination

The 2011 literature survey reviewed the use of the ICF for determining eligibility for access to services and participation in certain activities, e.g. it references studies on grant applications in South Africa.[20] Using the ICF for determining eligibility is the basis for a number of very important recent initiatives.

The ICF has been used for determining eligibility to educational services. The ICF was introduced in Portuguese education law in 2008 as the compulsory system to guide eligibility policy and practice in special education.[21] The ICF is used both in assessment and in the development of the Individual Education Plans.

The ICF has also been used in determining eligibility for educational services in Switzerland.[22] Starting in January 2011, Switzerland will be among the first countries to implement a multidimensional, context-sensitive procedure to

establish eligibility in education systems. This new eligibility procedure is based on the ICF, Children and Youth Version (ICF-CY).

Determining eligibility is not just confined to educational services. The London Paralympics is a recent example. The Paralympics Committee faced two significant challenges. It had to design systems based on a classification of functioning in order to allow for fair competition and it had to determine who is eligible to compete in these events.

In 2009, the Classification Code of the International Paralympic Committee (IPC) adopted a resolution to mandate the development of evidence-based systems of classification.[23] It specifically resolved to follow best practice as outlined by Tweedy, and Vanlandewijck (2011).[24] The key statement in this is, "*The International Classification of Functioning, Disability and Health is the most widely used classification in the field of functioning and health. To enhance communication, Paralympic systems of classification should use language and concepts that are consistent with the International Classification of Functioning, Disability and Health*".

Finally, one of the most important projects regarding the ICF and eligibility determination is the Italian framework developed by Francescutti et al (2009). [25] This builds assessment procedures into public services using a Person Environment Interaction Classification (PEIC) framework which is ICF based. The PEIC and the ICF-based protocol are the guideline and the data interpretation sources, respectively, for providing public services and benefits. They enable the assignment of persons to different services and the surveillance and monitoring of the services as time progresses. A key aspect of this work is the implementation of a protocol which documents the effect of personal support and other environmental factors.

V. ICF and Employment

The ICF has been applied to research in the employment sector. Some studies have examined the employment process for people with specific disabilities using the ICF.[26] Others have addressed the factors operating in the job retention process such as the assessment of return-to-work of long term absent employees as a result of back pain[27] and the way in which sick notes can be represented using the ICF.[28] One EU funded study, Stress Impact (2003-2005) surveyed over 2000 long term absent workers in 5 countries using a research framework derived from the ICF.[29] The study indentified a substantial set of environmental factors which acted as facilitators or barriers to return to work. In a study of the job seeking behaviour of people with disabilities and the recruitment practices of employers (Opti-Work 2005-2007), the ICF was used as the basis for developing mechanisms to assess the effectiveness of macro employment policies, the recruitment behaviour of employers and the job seeking behaviour of people with disabilities.[30]

The ICF has been applied in policy analysis and development in number of studies supported by Eurofound. One study examined disability and employment policies in seven European Member States from the perspective of long term absent workers.[31] It proposed a new model for characterising sickness absence and made recommendations on how employment policy can promote social inclusion for employees with chronic illnesses.

VI. ICF and Education

The ICF has a multifaceted role in education, some of which have been discussed in relation the determination of eligibility. In addition, the MAHDIE project explored the ways in which the ICF has been applied in various educational contexts across Europe and, in light of the evidence, developed a policy tool MAP-EP (Matrix for Analysis of Problems in Educational Planning). This is a matrix for comparing the use of disability categories and related information at different levels of the education systems and at different points of the educational planning process. For example, a special teacher needs different information to develop an individual educational plan than is needed to establish eligibility or to monitor the over-all outcome of all students at the end of compulsory education.

In the area of inclusive education, the ICF is being proposed as a suitable basis for representing the information required to document the needs of learners with disabilities. This is supported by Simeonsson et al (2008 and 2012) specifically in relation to education.[32, 33]

The usefulness of the ICF as a communication tool in education and other disciplines is noted.[34] This aspect of the ICF can serve as a common language across the multi disciplines involved providing inclusive services. Seelman proposed the ICF as a useful framework on which to base coursework for individuals across a wide number of fields, including the health professions, social work, psychology, and disability studies.[35] In the Allan et al. (2006) paper on inter-professional education it was concluded that a shared language and conceptual framework is essential to successful inter-professional collaboration. It proposed that the ICF could provide this shared language and a conceptual framework to transcend traditional disciplinary boundaries. In highlighting the value of the ICF, it argued that a strong foundation based on the ICF could enhance communication and encourage collaboration between multiple disciplines.[36]

As well the provision of a common language base across disciplines, there are other roles for the ICF in education. Belchior (2007) used the ICF for outcome assessment in work on boosting visual attention in older drivers using video games technology. By boosting visual attention improvements in driving and other activities are evidenced using ICF activity codes.[37]

In summary, the application of the ICF in the domains of education, employment, statistics, conceptual development and eligibility were addressed in the 2011 review.[38] The previous sections of the current review have augmented this with a description of additional initiatives and discussed many projects not referenced in that review. The following sections explore a category of ICF application not included in previous reviews of applications, i.e. the use of the ICF in the design of services and products.

VII. ICF and Universal Design

The basic premise of inclusive design philosophies is to create environments which are capable of being used by a wide range of people. The major approach to this is Universal Design (UD)[39] [40] [41] [42]. UD is defined as "*the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design*".[43] The Irish Disability Act (2005) explicitly mentions the impact of UD on Environmental Design.[44]

The UN Convention on the Rights of Persons with Disabilities (UNCRPD) emphasises the important role the Universal Design (UD) can play in promoting and protecting the rights of persons with disabilities.[45] The Convention defines UD as the design of products, environments, programmes and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design. Under Article 4 (General Obligations) States are required to "*undertake or promote research and development of universally designed goods, services, equipment and facilities, as defined in article 2 of the present Convention, which should require the minimum possible adaptation and the least cost to meet the specific needs of a person with disabilities, to promote their availability and use, and to promote universal design in the development of standards and guidelines".*

According to the World Report on Disability, UD is a realistic and economic component of developing inclusive environments even in developing economies.[46] It provided a number of examples of the application of a UD approach to different aspects of the physical environment. One important example was the application of universal design to emergency evacuation procedures from buildings and in enabling communications and assistance during evacuations.

The Report provided an account of ways in which UD is increasingly being adopted in bus and rail transport, the most important innovation being the low-floor transit vehicle. It acknowledged that many UD innovations in the transport sector are very costly for developing countries and called for more research to develop and evaluate inexpensive solutions suited to low and middle income countries such as lower first steps; better interior and exterior handrails at vehicle entrances; priority seating; improved lighting; raised paved loading pads where there are no pavements; and eliminating turnstiles.

A wide range of UD solutions to information and communications systems were identified such as enhancing the cognitive accessibility of mobile phones for people with intellectual impairments through large back-lit keyboards, simple menus and access options. The report echoed the call by representative organisations of people with disabilities for the increased use of UD as a way of becoming more proactive rather than reactive in creating accessible technologies. It noted that guidelines for designers and operators of websites for delivering accessible content to hand-held devices are being developed by the World Wide Web Consortium (W3C).

There are many approaches to inclusive product design. Universal Design is a major approach to the development of products. The product design approach of McAdams and colleagues is gaining currency. It is based on an architectural view of Universal Design. Its key component uses Action Diagrams which represent interaction with everyday products such as baths to link to ICF Activity Codes.[47]

That there is a need to link the ICF to Environmental projects is acknowledged by noted commentators such as Steinfeld and Danford (2006). [48,49] Universal Design, which originated in the design of the built environment, is the focus of a study which looks at how the ICF can be used to characterise adherence to the principles of UD.

In spite of its limitations, there are some environmental applications of the ICF worthy of mention. For example, a Dutch study which proposes Universal Design Patterns to achieve inclusive built environments which considers the ICF.[50]

VIII. ICF-based Design Initiatives

This section describes a number of design initiatives which have used the ICF as a component of the design process. Many of these systems use the ICF as a basis of representing people, in their domain of application. Typically a characterisation of disabled or elderly people is provided using a subset of the ICF such as the ICF Checklist.[51] Some record of the person's body structures and functions is provided along with some personal factors such as age and gender. The Virtual User Models (VUMS) cluster of projects is a recent initiative which looks at standardising the user model for inclusive design and considers a richer user characterisation than the ICF checklist.[52] It is interesting to note that in its representation of the user it uses many ICF codes but also contains many personal factors.[53]

The ICF is also used to represent activity and tasks. The work of McAdam and associates, for example, records interaction with products as a sequence of ICF Activity Codes as part of the requirements analysis household product development.[54] Gilligan and Smith also used the ICF as part of their representation of everyday activities.[55] This work also considered using the ICF to represent interaction with products.

The use of the ICF in environmental design has also been considered (products are considered environmental factors in the ICF). However ironically, the ICF's own environmental codes have had limited application.

Design initiatives comprising of three broad design categories - design of services, design of products and design of the environment are discussed below.

Design of Services

Service Design is a complex multifaceted process and varies considerably from domain to domain.[56] Dimensions of services vary widely in terms of cost, availability, regulation, resources, governance and quality control amongst others. There are business to business services, business to individual services, public and private services, funded services and voluntary services. For example, Humphreys (1998) discusses in considerable detail the significant differences in public services across Europe.[57] Such a variety and range of service paradigms has inevitably lead to considerable debates as to what constitutes a service.[58,59] Designing accessible services is no less complex and the ICF has a varied history as part of this process.

Traditionally, the ICF has been used in the provision of healthcare services. Bruyere et al. list many of these applications across nursing, rehabilitation, psychological services and more.[60] The role of the ICF in clinical practice is varied. At a macro level, the ICF is being used for monitoring international and national policy implementation by linking policy targets and indicators including access to services with the respective data sources.[61]

In terms of service provision, the ICF is used in documenting and coding the functional status information for purpose of assessing patient needs, planning health and social care and for measuring the changes brought by interventions across a multitude of dimensions from body functions to personal activities, societal participation and environmental factors. Various countries have or are in the process of implementing projects where ICF is used in assessing the disability status of individuals in order to determine their eligibility for health, social, or educational services. The ICF promotes better communication and encourages a holistic view of disability. This improves the solutions on offer. While health services are an important application for the ICF, it has also been used in the development of inclusive everyday service delivery.

A typical role for the ICF is in the definition of the population who will benefit from inclusion. The ENAT accessible tourism initiative is one such example. ICF definitions of disability are used in introduction on the domain of disability and the ICF is used to characterise the population of customers with disabilities.[62] For example, a British study in 2012, evaluated the ICF as a framework for interviewing people with a visual impairment about their mobility and travel.[63]

Some service systems use the ICF to characterise individual clients with disabilities in contrast to a representation of groups of users. The First Responder system, for example, uses an ICF shortlist as the basis for a user with a disability profile in order to facilitate emergency service personnel to properly deal with patients with disabilities.[64] This reflects the growing role of the ICF as a representation mechanism for people when inclusion is being considered. In a review of applications and technologies oriented towards disabled and senior people, the ICF is included as a part of a standard representation of the person's capabilities.[65]

While the use of the ICF as the basis for user modelling is a major component of the design of assisted living services for people with disabilities and older people, other roles are also suggested within this domain. These include planning and monitoring of service delivery and recording the performance of activities within the domain.[66]

While applying the ICF to the design of general service delivery is at an early stage, it will have a significant future role, particularly if the personal factors being developed by Geyh are included in future updates.[67] Many of these factors such as personal experience and expectations are the basis of major service quality assessment instruments such as SERVQUAL.[68] Used in conjunction with ICF based economic tools this offers significant potential for expanding the role of the ICF in analysing inclusive service delivery.[69]

Design of everyday products

In a landmark study in 2000, the UK Department of Trade and Industry highlighted the difficulties people with disabilities have with everyday products, such as bags of sugar, milk products, and shoe polish amongst others.[70] The large numbers thus affected, indicated the level of impact of product design. The ICF is linked to this study, to a certain extent, as everyday objects are considered to be environmental factors. The actual basis of analysis was Fisher's Assessment of Motor and Process Skills (AMPS). This is in turn linked to the ICF.[71,72] The DTI study forms the basis for the Cambridge Inclusive Design approach, so its influence extends to one of the more significant product design approaches.[73] However, a more direct role is proposed for the ICF in other inclusive design initiatives.

As stated earlier the ICF is proposed as a standard representation of the person's capabilities in virtual user models (VUMS).[74] An interesting project belonging to the VUMS cluster, that uses the ICF and deals with the issue of representing people interacting with objects, is the VICON project.[75] It aims to help product designers take account of the needs of blind and partially sighted users. VICON aims to develop a Virtual User Model using information collected during interviews, and in particular focusing on the key issues that people reported with

the products. This is a set of computer-generated characters that simulate humans. The movement and behaviour of these virtual humans can be programmed in such a way as to mimic varying levels of impairment in vision, hearing and manual dexterity. In theory, a designer could test and improve the accessibility of a product design before it is even prototyped. VICON intends to use the ICF as part of virtual user profiles. In product design and manufacturing the notion of digital humans and virtual environments is becoming more and more commonplace, for example in car manufacturing.[76, 77, 78]

A more traditional application of the ICF, which has implications for everyday product design, is in the design of AT interventions. The use of ICF to characterise AT interventions has relevance in the sense that many of the products in AT databases are everyday products. These are referred to as Universal Technologies.[79] The ICF is used for AT device classifications.[80] In addition there is a Dutch proposal, which links the International AT Standard ISO 9999 to ICF codes.[81]

Many profiling instruments in AT service delivery have also been mapped to ICF Codes, for example Scherer's MPT instruments.[82] Some of these efforts acknowledge the challenges of reconciling the different terminologies used in these instruments to the ICF.[83]

While the relationship between the ICF and product design is still in its early stages, it will be interesting to see how the approaches cited here develop. Personal factors, such as self efficacy and customer satisfaction, have been used as variables to analyse the behaviour of consumers. The commercial value of product development is very much dependent on these.[84,85]

Design of environments

While the ICF has begun to impinge widely on the design of services and of products including Assistive Technology, consideration of the design of the environment and the ICF is surprisingly limited. This is particularly the case because a major component of the ICF relates to the classification of environmental factors which is widely acknowledged as one of its unique characteristics.

The ICF has been proposed as a comprehensive model for a holistic approach to the design, development and evaluation of Ambient Assisted Living (AAL) services for older adults, which has a built environment component. However, some commentators contend that using ICF environmental factors as they currently stand represents a significant challenge.[86] Sandford and Bruce (2009) offer a detailed critique the role of the ICF in articulating environmental concerns.[87] It lists difficulties such as the inconsistency between the way environmental and other qualifiers are used, the inability of the ICF to code

environmental demands and its exclusion of some attributes of environmental constructs.

Sandford and Bruce propose an extension of the ICF environmental component with a view to remedying its shortcomings. Bruce further reflects these issues when the use of the ICF was considered with respect to building inclusive exhibits, specifically the Atlanta Aquarium.[88]

While the ICF has its limitations in respect of environmental design, the fact that it has attempted to define the role of the environment in enabling or disabling people has broadened the discussion of environmental issues in the planning stage of the design process. For example, the consideration of factors such as the family and supports in service design can result in more robust and effective solutions.

The ICF classifies environmental factors other than the physical environment. These include support and relationships, attitudes and services, systems and policies. These non physical environmental factors of the ICF will continue to play a significant role in the development of inclusive social provision, for example in establishing systems to deal with refugees.[89]

3B: Overview of related resources

In the preceding section an overview of applications of the ICF was presented. In this section, related resources are discussed. These are systems and approaches which are not ICF derived which attempt to specify a wide range of concerns including human functions, abilities, the relationship between the environment and a person and the performance of tasks and activities. In doing so, they may be seen as a means of augmenting the ICF deficiencies in relation to the environment and personal factors.

While there is overlap between elements of each approach, the origins and intent of these resources can be very different. For example Fisher's Assessment of Motor Process Skills (AMPS) is an instrument to assess performance of everyday activities such as making a cup of coffee, while the primary purpose of the Systematized Nomenclature of Medicine -- Clinical Terms (SNOMED-CT) is to support the effective clinical recording of data with the aim of improving patient care.[90,91] See Annex 2 for a more detailed description. Similarly, Scherer's Matching Person and Technology (MPT) profiles potential Assistive Technology users to reduce future abandonment.[92,93] Keate's and Clarkson's Inclusive Design approach appraises user capabilities with respect to product design.[94]

The shared constructs of these approaches fall along similar lines to the ICF components and embrace concepts of Body Structures, Functions, Activities, Environment, and Personal Factors, However, in many cases they differ in terminology.

SNOMED-CT has thousands of Body Structure Concepts, defined across organs, skeleton, bone and joint structures and more. It offers great detail. For example, it defines every finger and parts of fingers. Ergonomic approaches also render body structure in terms of anatomical measurement. These measurements are available in commercial databases such as the CAESAR 3-D Anthropometric Database, North American Edition.[95] This extensive database product includes measurements from the entire North American population sample (2,400 male and female subjects, aged 18-65) including demographics (in comma delimited text and Excel spreadsheet formats). Measurements are classed into percentile ranges across the measured population. Computer Games Programming which produce virtual humans also achieve realistic proportion in their animated characters using these databases.

Body Functions and Activities are also described in many resources. In the Assessment of Motor and Process Skills (AMPS) instrument, the quality of a person's Activity of Daily Living (ADL) performance is assessed by rating the effort, efficiency, safety, and independence of 16 motor and 20 process skill items, while the person is doing chosen, familiar, and life-relevant ADL tasks. Motor skills, such as reaching, gripping, lifting, transporting and manipulating, and process skills, such as initiating, sequencing, terminating organizing and navigating, are used when analysing the capabilities of the person. SNOMED-CT also has an extensive library of activity as well as body function concepts.

Keate's and Clarkson's Exclusion Calculator in their Inclusive Design Toolkit measures capabilities such as vision, hearing and dexterity which are considered as body functions or activities in other approaches.[96] The exclusion audit was based on a DTI (2000) study results which showed that large numbers of people with disabilities had difficulty in using everyday consumer products. The study used a methodology based on AMPS to analyse people's capabilities in respect of gripping, lifting and manipulation amongst others.[97] It estimated that over one million people had real difficulties in opening jam jars.

Body functions and activities in computer games programming are often defined as Agent Behaviours. However, they embrace complex planning mechanisms in order to present appropriate onscreen agent activity. Often this activity is guided by formally specified activity plans such as Badler's Parametrized Action Representations which link together the activity, the body structures involved and the physical location in one construct.[98]

The impact of the physical environment on activity performance and participation is a central concern. For example, lighting is an important environmental factor that impacts on action performance. Studies have been done to compare occupational performance in differently lit contexts.[99] People produce different performance levels depending on light strength and features.

The representation of the environment is also very challenging and varied amongst different resources. For example, SNOMED- CT lists many kinds of physical location from agricultural settings to the family home.

There are many approaches that analyse the impact of the physical environment on activity. Space Syntax methods and theories quantitatively reflect aspects of navigating whole environments. Tversky, for example, uses these methods to show representations of settings which are accurate predictors of travel choices people make.[100] Elizabeth Shove, in The Design of Everyday Life, introduces the concept of practices (Activities and Function) where the key relationships are between Image (Self Image), Stuff (Materials, technologies and artefacts) and Skills (competence and taste). [101] The triple of Image, Stuff and Skills certainly echoes the components of Person, Environment and Activity. In Scherer's MPT models technology elements that are considered important include, Comfort, Performance, Cost, Availability, and Appearance.[102]

As in Shove's model, the necessity to model interactions between an object and a human agent (albeit a virtual one) appears in most applications of computer animation and simulation. Such applications encompass several domains. Examples of such domains include virtual autonomous agents living and working in virtual environments, human factors analysis, training, education, virtual prototyping, and simulation-based design.[103]

Commonly, simulation systems perform agent-object interactions for specific tasks. An interesting way to do this is to model general agent-object interactions based on objects containing interaction information of various kinds: intrinsic object properties, information on how-to-interact with it, object behaviours, and also expected agent behaviours. The smart object approach, introduced by Kallmann and Thalmann, extends the idea of having a database of interaction information. [104] For each object modelled, they include the functionality of its moving parts and detailed commands describing each desired interaction by means of a dedicated script language. Smart object representations reflect the ideas of Gibson's affordances.[105] It is not unlike the encoding of activity sequences which are used in Sangelkar and McAdam's design work discussed earlier.

Quantitative data around the environment is used in many resources. This data can include numeric data around environmental dimensions across all classes of environmental information. For example, it might include clearance space dimensions and light status (whether it is on or off) from the physical domain, data on an individual's wealth, family size (from the support and community environment) and specific applicable legislation reference codes amongst others.

Clearance space is an important concept in accessible standards. The area in which the action takes place must be sufficiently large to allow actions involved such as lifting and reaching and turning to take place. Standards, including

accessible standards, are available, such as those from the National Kitchen and Bathroom Association which specify appropriate clearance dimensions.[106]

Games programming also uses measured data to represent its virtual environment often from CAD plans of real built environment projects.[107] This gives realism to the game. *Serious Gordon,* for example, is used to teach catering staff hygiene protocols. [108] Its virtual world is derived from the plans of a real catering kitchen.

Scherer also stresses the importance of environmental factors other than the physical environment. In the MPT model, the environment is referred to as the Milieu and includes factors such as Legal Mandates, Support and Family amongst others.[109] Universal Design for Instruction reflects this holism in its promotion of a class climate which is based on practices that reflect high values with respect to both diversity and inclusiveness.[110] SNOMED-CT lists many of these factors under the social contexts concept. Many of these related resources concern Personal Factors. Scherer's MPT instruments assess preferences, needs, motivations, expectations, lifestyle and more.

The Handbook for Analyzing Jobs (HAJ) lists many functions and activities in its Checklist of Demands.[111] This is described in more detail in Annex 2. One significant output of the procedures was the Dictionary of Occupational Titles (DOT) which contains definitions of over 13000 occupations.[112] The Occupational Information Advisory Panel to the Social Security Administration reviewed the DOT in 2009. The application of the ICF to a new Occupational Information System was considered but no strong recommendations were made.[113]

The approach underpinning the HAJ involves matching the characteristics of a person in terms of physical, mental and psychosocial abilities with the physical, mechanical, cognitive and social demands of a job. The main elements include worker functions, which relate to how an employee must process data, his or her relationship to other people and what he or she must do to things. It also includes work fields, which classify the methodologies and techniques used in a job; the machines, tools, equipment, and work aids used; the materials, products, subject matter, or services which are produced and worker characteristics, which can contribute to successful job performance. There is some overlap between the functions specified in the HAJ and the ICF although the HAJ focuses on personal factors, such as temperament, influencing people and tolerance, and goes into details in describing the physical demands associated with tasks including, for example, the weight of an object to be lifted and the distance it must be carried. These are aspects not well covered by the ICF.

Anthropometric data, such as hand length and breadth and reach envelopes, can also be considered personal factors. While this kind of data could be included as a subset of personal factors, it is useful to delineate anthropometric data from general personal factors, due to its significance in design inclusion.[114]

The field of ergonomics is another related resource.[115] Ergonomics aspires to optimise human wellbeing and overall system performance. The approach to this focuses on the interaction between a person and other elements which can include another person, a machine or more complex systems. Two important ergonomic concepts relevant to this study are accessibility, which refers to the extent to which products, systems, services and facilities can be used by people with the widest range of characteristics and capabilities, and usability, the extent to which these can be used to achieve specific goals efficiently and in terms of user satisfaction. The discipline of ergonomics also takes account of the physical, social and organisational environments within which interactions take place. An innovative model of occupational rehabilitation was proposed in 2008 which integrated the application of ergonomics with the ICF.[116]

Issues of terminology

While the preceding overview of related resources is organized around 'common' conceptual ground with the ICF components, it must be acknowledged that there are terminological issues with defining the exact nature of this ground. For example, the ICF defines **Activity** as the execution of a task or action by an individual and **Body Functions** to be the physiological functions of body systems (including psychological functions). While this is an apparently clear distinction, the AMPS Motor and Process Skills link to codes relating to both of these ICF components. For example, the Motor Skill of stabilizing body position seems to be covered by body function code b715 (Stability of joint functions) whereas AMPS Motor Skill Reaching links to activity code d4452 (Reaching). As a result, different Motor Skills concepts are linked to both ICF Body Function and Activity codes.

AMPS Motor and Process Skills are presented as a list of labels with numeric values attached. In a smaller form these instrument items offer, like the ICF, a taxonomic classification of codes. In contrast, SNOMED CT defines a class hierarchy which comes with a language, including data type definition that allows for the formal expression of medical concepts. So there is no direct match between similar constructs. Items can be linked at different levels of the hierarchy.

The AMPS provides a set of scaled qualifiers for each item, which is the inverse of the ICF qualifiers. A rating of 4 indicates Competence and 1 indicates Deficit in the AMPS scale whereas 0 indicates No Difficulty and 4 Complete Difficulty in ICF.

In relation to Activity and Participation, the ICF uses the terms Capacity and Performance. There are numerous and sometimes conflicting definitions of these available in related fields. The ICF definitions of these terms were presented in Section 2 of this review. Effectively capacity, in ICF terms refers to the limitations in activity or participation a person would experience based solely on their own

abilities. Performance specifies what individuals do in their current environment including environmental barriers and facilitators.

But there are many others definitions of performance. In the Ecology of Human Performance model performance is defined as being composed of the process and the result of the person interacting with context to engage in tasks. [117] The transaction between the person and the context determines the performance range.

To illustrate the blurred boundaries between the concepts of performance and capacity, it is worth noting that in the model of Human Performance (MOHO) a construct called **Performance Capacity** is defined. This indicates that like many of the domain concepts under discussion there are no uniformly defined concepts. It points to the advantage of a taxonomy with a wide reach such as the ICF.

Other terms for which a greater clarity is required relate to what a person can do. A range of terms are used including human abilities, capabilities, and function. For example, worker functions as defined in the HAJ are largely related to ICF Activity and Participation codes and both ICF Body Function and Activity codes map onto job demands.

While a number of conceptual difficulties exist in the different approaches to defining the domain it is worth noting that many of these resources have been mapped to the standard terminology of the ICF with varying degrees of success.

3C: Reasons why the ICF and related resources have been integrated into non-medical systems and domains

Previous sections of this review have explored numerous applications of the ICF across many domains and systems. This section examines the reasons that those charged with responsibility for those initiatives considered the ICF for use in the first place.

The ICF appears to offer many benefits. It is a tool endorsed across the international community, signed into being by 191 countries and belonging to the WHO family of international Classifications. It has also been translated into a number of languages.[118] The ICF is a comprehensive multifaceted classification which has components relating to the Person (Body Structures and Body Functions), Activity and Environmental Factors. In a way this reflects the PEO (Person Environment Occupation) models of occupational therapy. [119,120,121]

It provides a common semantic base for describing concepts consistently across different languages. This element is considered of particular importance in transnational enterprises. In establishing evidence based practice for classification in the Paralympics, Tweedy describes the advantages the ICF brings.[122] These are:

- The concepts of functioning and disability are contemporary and internationally accepted;

- The definitions for key terms are clear, unambiguous and internationally accepted.

The key terms and concepts of the ICF are described in a variety of languages including English, French, Spanish, Russian, Chinese and Arabic and therefore people from a range of non-English speaking backgrounds can use the key aspects of the system in their own language without ambiguity, thereby removing a significant barrier to the international understanding of the system.

Eight eligible impairment types across both function and body structure are classified and all are mapped to either s or b ICF codes.

The ICF provides a common language for consistent statistics and information gathering exercises in the domain of disability and participation amongst the elderly. The Australian ICF User guide states "*the use of a common framework, with its common definitions and classifications, thus helps to produce meaningful information for decision making and policy development and increases the likelihood of improved outcomes for people with disabilities*".[123] The guide cites the example of how common concepts across a number of instruments, prior to the release of the ICF were central to a revised upward estimate in service provision needs for those with disabilities.

The Australian User guide also lists examples of how the ICF has helped to provide meaningful domain data for example in the analysis of outcomes. Population survey data were analysed to look at the participation of people with disabilities in relation to living arrangements and self-care; housing and homelessness; self-perceived health; mobility and transport; communication; social relationships and community life; time use and leisure; education; employment; and economic life.

A number of related resources have already been linked to the ICF in terms of content and terminology. The PEIC framework described previously is a case in point. An interesting example of this interaction between environment and participation, and how it can be articulated using the ICF is cited in a Letter to the Editor of the Journal of Rehabilitation Medicine in 2009.[124] It describes a swimmer who is independently mobile on land with apparently minor bilateral ankle arthrodeses, but who is profoundly restricted in propulsion for swimming.

The ICF is computationally friendly, which means that it is amenable to quantification, and this has led to formal models of domains of application based on ICF constructs. For example, the ICF was included in a formal computer based knowledge representation scheme which could specify Activities of Daily Living[125].

Another important advantage of the ICF is that a set of systematic rules has been developed. This can ensure that there is consistency in the approach taken when mapping terms and concepts in related resources regardless of the domain in

which this is being implemented. The procedure for linking concepts to the ICF is typically done through a process of 'cross-walking' from the concept being represented to an appropriate ICF code. The term 'cross-walking' originated in attempts to map profiling instruments such as Scherer's MPT to the ICF.[126]

Rules for linking to the ICF were proposed by the ICF monitoring body in 2002 and these were upgraded in 2005. [127,128] These are described in more detail in Annex 1 to this review.

Many of these benefits are articulated in major reports and protocols and two of these are described below. The first of these is the UN Convention on the Rights of Persons with disability. One of the conclusions of the 2011 survey is that the ICF will become increasingly important as a tool for monitoring the Convention particularly because it opens up the possibility of a common metric.

The second major endorsement of the ICF to be considered is the World report on disability. These will then be followed with a more detailed discussion on how the above themes are common to a number of major initiatives.

UN Convention on the Rights of Persons with Disabilities, ICF and Accessibility

The UN Convention on the Rights of Persons with Disabilities (UNCRPD) entered into force on 3 May 2008 along with its Optional Protocol, which allows individuals to bring petitions to the Committee on the Rights of Persons with Disabilities claiming breaches of their rights and gives the Committee authority to undertake enquiries of grave or systematic violations of the Convention.[129] It is a legally binding international Human Rights treaty. Those countries that ratify this Convention commit themselves internationally to implementing its provisions.

People with disabilities are addressed as persons with rights and a full role to play in society and not only as patients needing a cure. The UN Convention provides governments, the disability sector, industry and service providers with a clear framework for ensuring people with disabilities are treated fairly and equitably in all aspects of life.

To date 153 countries have signed the Convention and 90 countries have signed the Optional Protocol. Of these 119 countries have ratified the Convention and 72 have ratified the Optional Protocol which means that the UNCRPD has been integrated into their national legislation.

There are a number of correspondences between the UNCRPD and the ICF when it comes to the meaning of disability. In its Preamble the Convention recognises that *"disability is an evolving concept and that disability results from the interaction between persons with impairments and attitudinal and environmental barriers that hinder their full and effective participation in society on an equal basis with others'*. The ICF conception of disability is very similar when it

specifies disability as a "*a dynamic interaction between health conditions (diseases, disorders, injuries, traumas etc) and contextual factors*"

Article 9 (Accessibility) requires States to take appropriate measures to ensure to people with disabilities have access, on an equal basis with others, to the physical environment, transportation, information and communications, other facilities and services open or provided to the public, both in urban and in rural areas. It makes specific reference to promoting "*the design, development, production and distribution of accessible information and communications technologies and systems at an early stage, so that these technologies and systems become accessible at minimum cost*".

ICF in the World Report on Disability

The World Report in Disability, compiled by the WHO and the World Bank, was published in 2011. The initiative involved over 370 editors, contributors and other participants from 74 countries. The ICF was adopted as the conceptual framework for the report on the grounds that it characterises functioning and disability as a dynamic interaction between an individual with a health condition and his or her context in terms of contextual factors. The report considered the ICF as a 'workable compromise' between medical and social models, often referred to as a biopsychosocial model.

The World Report provided a global perspective on Disability which it specified as an umbrella term for impairments, activity limitations and participation restrictions i.e. the negative aspects of the interaction between individuals and environmental and personal factors.

At the core of the World Report was a focus on ways of enhancing accessibility, equal opportunities; participation, inclusion; autonomy and dignity. It reviewed disability data on the status of persons with disabilities worldwide and explored the situation of people with disabilities in a number of sectors including mainstream health, education and employment. It also discussed rehabilitation, including therapies and assistive devices and support services.

From the perspective of the current review its exploration of inclusive environments is most interesting. The Report addressed not only physical access to buildings and transport, but also to information and communication technologies.

To summarise, many diverse examples of applications of the ICF were presented in the previous subsections. This subsection reviewed the reasons why the ICF was included in these projects. These reasons ranged from the international endorsement of ICF, its translation into many languages, its provision of a common language for characterising the domain to the provision of consistent data sets. Given the sheer range of applications in which it has been integrated and given the size and scope of many of these, for example the IPC classification

codes, it is clear that the ICF is an important and major element in the promotion of an inclusive society.

However it is not without its critics. Barnes, while acknowledging its definition of disability is broader than the contentious ICIDH classification, points out that it still retains links to controversial ICIDH definitions such as impairments and their association to "*significant variation from the statistical norm*".[130] Of more significance though is the opinion offered, the Personal Factors component: the "*…exclusion of such factors undermines the broad-based ambitions of the ICF*". However, for all that, Barnes concedes that the ICF "*draws attention to the impact that the physical and cultural environment has on disablement. Hence contemporary infrastructures are now viewed by people with disabilities and their organisations as a visible example of societal neglect of disability issues*".

It is clear that there are differing opinions as to the effectiveness of the ICF. In the next subsection how the ICF has impacted on non-medical systems and domains is discussed.

3D: How the ICF has impacted non-medical systems and domains

In this subsection the impact and usability of the ICF is considered, in relation to non-medical systems and domains. To illustrate the challenges involved, consider the components of the following analysis of moving objects from location to location carried out by the Centre for Universal Design. This is a good example of the composition of elements in an everyday task and how they interact with each other.[131] It considers the activity of load carrying and the objects involved. It looks at how the application of Universal Design principles might impact on the performance of the activity and on the well being of the person.

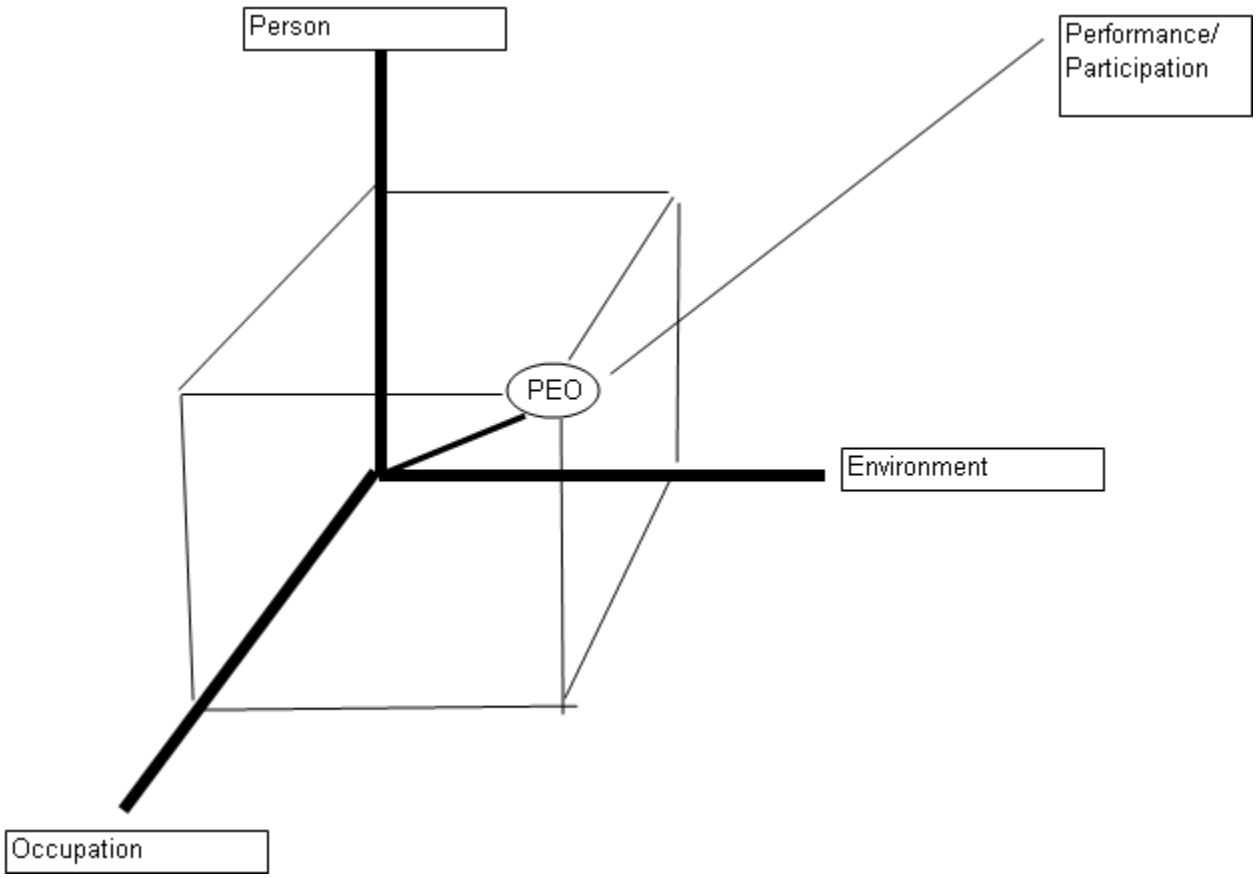
A person is faced with the task of carrying objects on a tray from one location to another. Because the tray has no handles the person carries it using a single hand. This task takes place in an environment with shiny slippery floors and involves opening and closing a door with a club head door-handle. The heavy load and the repeated adjustments to prevent falls take their toll on the person's health.

To improve matters, UD principles are applied holistically to all elements involved. The physical location is redesigned so that the floor uses a surface with a better grip and the door is changed to one that automatically opens. The tray is redesigned to include two handles, which in turn changes the activity to carrying a load using two hands. The resultant improvement in carrying technique reduces the stress on the persons back and arms and improvements in the floor texture reduce the risk of falling. All of this brings about an improvement in the health of the person over time. This example also illustrates the close relationship between ergonomics and UD.

Changes in the design of the environment, including the tray, brought about changes in the way the task was performed, which in turn improved the well-being

of the person. The three dimensions of Person, Activity and Environment and how they react are central to the approach. This is summarised in Figure 2.

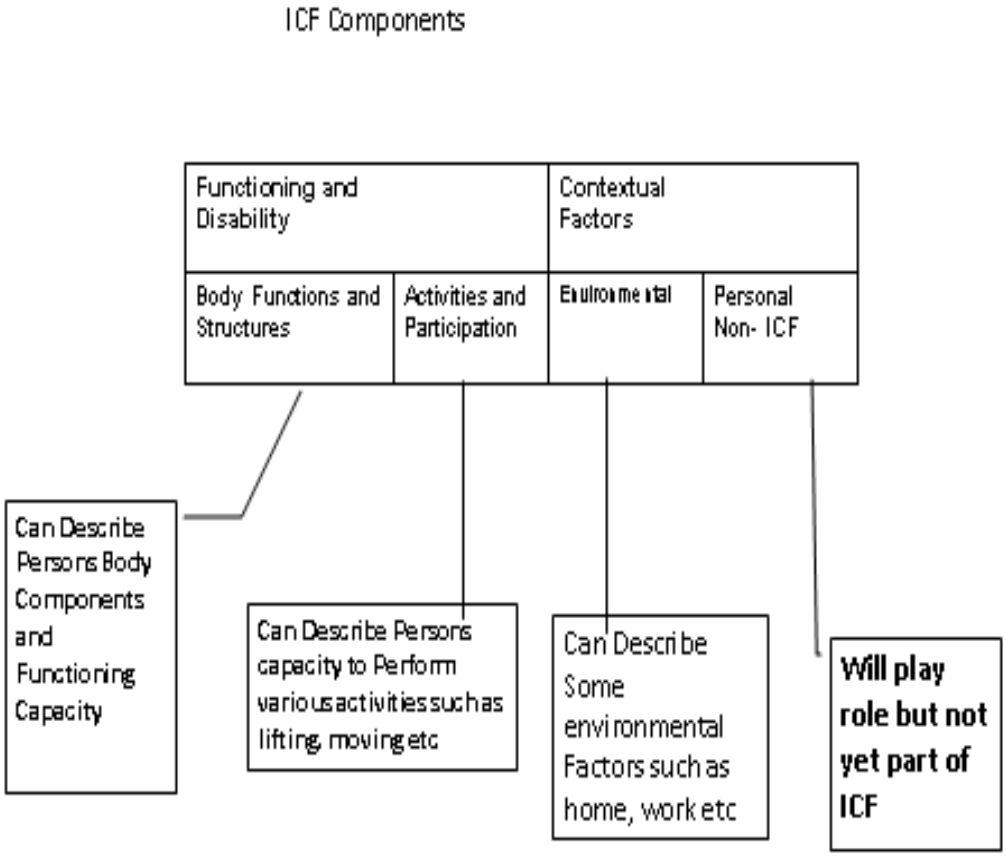
Figure 2: Design Considerations



The potential effectiveness of the ICF in describing these systems is supported on a number of grounds. The ICF is a comprehensive set of codes, describing many concepts. It would seem to be a viable representation scheme for the elements of many design and development paradigms. The body structure and function codes can be used to describe a person using a product or service.

It has activity codes which can describe the tasks and subtasks involved in using a product or service and finally it has environmental codes which can describe the physical and social domain of use. These elements are summarised in Figure 3.

Figure 3 Representation and ICF components



It can be seen from Figure 3 that many elements of the Person representation map directly to the ICF. These include Body Structures and Body Functions. There are elements of the ICF to describe Activity and Participation and so on. The ICF also has a number of codes dealing with Environmental Factors. For these reasons, the ICF seems to be a promising basis upon which to represent components under consideration.

In the survey of applications, a number of initiatives were described which used the ICF checklist as the basis for representing person, including the VUMs cluster of projects and serious games to teach First Responders.[132]

In terms of activity representation and the ICF the design approach of Sangelkar and McAdam is noteworthy. Sandford and Bruce offered a considered review of the issues, including the confusion caused by multiple operational constructs in the environmental qualifiers. Generally, as evidenced by the large number of applications the ICF is a useful and robust classification, which is very wide-ranging classification in terms of functions and activities and participation.

However it also has a number of limitations which are discussed in the next subsection.

Areas where the ICF is in need of development or augmentation

There are gaps in the ICF in spite of it having more than 1400 codes. Barnes highlighted the issue of the Personal Factors component and this is a major issue. Personal Factors are the particular background of an individual's life and living, and characteristics of an individual that are not part of a health condition or health states. These factors may include gender, race, age, fitness, lifestyle, habits, upbringing, coping styles, social background, education, profession, past and current experience (past life events and concurrent events), overall behaviour and character style, individual psychological assets and other characteristics, all or any of which may play a role in disability at any level.

Personal factors (PF) are not classified in ICF. However, significant work is being done by ICF researchers led by Szilvia Geyh to identify Personal Factors with a view to establishing this component in future revisions of the ICF.[133] The specific aims of this work are to identify papers that contain information about the ICF and explicitly mention the PF, to analyse PF-related content of the papers and to gain an overview on the notion of PF in the literature.

Work done to date has identified some 255 personal factors from a detailed search of ICF based literature sources. These include factors such as esteem, motivation, self-efficacy, and expectations amongst others. Many of these factors are important in the consumer experience of everyday products and influence their success or failure.

As well as PF there are other notable omissions. Important instruments to assess the capability requirements of activity such as the Assessment of Motor and Process Skills AMPS identify process and other requirements which are not described in the ICF.[134] The ability to search for and locate objects required in task completion, for example, is not described in the ICF.

Anthropometric data, such as hand length and breadth and reach envelopes, have also been shown to be of central importance in using objects to carry out tasks. For example, in order to lift an appliance, such as a kettle, the width of the agents hand must be sufficient to grasp the kettle handle, given its diameter.

The work of Clarkson and others highlights the importance of anthropometric compatibility in the use of everyday objects.[135] While this kind of data could be included as a subset of PF, it is useful to delineate anthropometric data from general personal factors, due to its significance in design inclusion. This work proposes the introduction of a third subset of agent attributes, containing anthropometric measures for that individual.

ICF codes are context independent in the sense that codes representing the ability to walk, for example, do not reflect whether or not the person has to walk 20 miles or 10 yards.

Consider an everyday activity such as making tea. The person making tea will have to lift a number of different objects including the kettle, teapot, tea caddy, sugar bowl and so on. All of these actions have different requirements and on this basis it is necessary to distinguish between them. The ICF code D4300 (Lifting and carrying objects) is not explicitly bound to specific objects and hence does not distinguish between different instances of lifting.[136] This distinction is not possible without documenting this additional non-ICF information.

Often the defining characteristic of the physical environment is the set of objects involved in the activity. It is worth noting that, while the ICF has a section on products and technology, it offers no real mechanisms to describe objects in the same way for example that SNOMED-CT does.[137]

Finally, while the ICF provides a comprehensive list of environmental codes, it is by no means exhaustive. Other non-ICF environmental concerns are raised in relation to the repair record and maintenance requirements of the technology.[138]

The ICF, for all its limitations, is a powerful representational tool. In the 2011 Survey papers were almost divided up chronologically- Concept and clinical papers arrived before 2008 and applications in non-medical systems emerged after this date. Most of the design initiatives described in this review are post 2009. A new and exciting era for the ICF has emerged and with appropriate augmentation it will be a formidable classification system.

4. Conclusions and Recommendations

This review has explored 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. It has also addressed the impact of an ICF informed approach in each of the non-medical systems and domains reviewed.

In a review of papers addressing the ICF (2011), it was evident that between 2001 and 2008 the primary content and focus of research was upon conceptual and clinical issues. After this date there has been a marked shift towards the application of the ICF in a very 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[139].

Conclusions:

The ICF 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. This can be attributed to a number of key features of the ICF.

- It has been designed so that it can be used to describe systematically human functioning in general (all people) and not merely disability, and is based on a universal model of functioning and activity rather than a minority model;
- It is designed as an operational tool for application to people in all stages of the life span including older people;
- It provides a systematic way of:
    - Documenting human functioning in terms of functional capacity, carrying out activities and participating in life situations,
    - Documenting the impact of the environment on activity and participation,
- It describes an interactive process in which the relationships between function, activity and participation are not linear progressive but are amenable to change, in particular, through adapting environments;
- The classification is equally relevant to congenital, developmental, or acquired differences in functioning including those that emerge as a result of ageing;
- The language of the ICF is neutral, unlike the terminology associated with many deficit-based classification systems;

- It incorporates not merely biological aspects of a person but also the psychological and social element, thus it combines both medical and social models.
- It has been adopted in 191 countries;
- It provides a unified and standard language and framework for describing human functioning and the impact of the environment;
- The terminology used in the ICF is consistent, clearly defined and unambiguous and is available in many of the major languages in the world including Arabic, Chinese, English, French, German, Japanese, Russian and Spanish;
- There are explicit and widely accepted rules for linking the ICF to other frameworks and classifications which have been evaluated and updated. This means that a systematic approach can be applied across systems and domains;
- The ICF is computationally friendly which means it can be used in ICT based applications;
- The ICF is congruent with the UNCRPD and its use is recommended in the World Report on Disability.

Given the advantages that the ICF offers as an international classification, it is not surprising that it has been used in a range of domains to good effect. In addition, to its wide acceptance in most allied health domains, such as occupational therapy, physiotherapy and psychology, other notable applications identified by the current review are:

- International data standards: It has been generally accepted and widely used to set international standards for gathering statistical and demographic data;
- Inclusive education: It has been adopted as the most appropriate framework to support inclusive mainstream education by providing a mechanism to identify students in need of additional learning support and matching their needs to appropriate tools and interventions.
- Employment: It has been applied in research to develop explanatory models of the recruitment behaviour of employers, the job seeking behaviour of people with disabilities and factors in job retention and return to work.
- Social security: It has been adopted by social insurers as the underpinning framework for determining eligibility for income support and services.
- Social policy research and design: It was the framework used in the World Disability Report to document the impact the environment on people with disabilities in 70 countries in terms of participation and poverty and is being used in documenting the response of State Parties to the UNCPRD.
- Sport: The International Paralympic Classification Code has been influenced by the ICF in terms of the language and terminology used and

its underpinning concepts in order to allow for fair competition and determine eligibility for specific events.

- Tourism: The European Network for Accessible Tourism (ENAT) has used ICF definitions to describe the customer characteristics for which local resort and holiday areas need to cater.

In the field of design, the ICF has been used in a number of initiatives which attempt to link human characteristics to environmental features.

- The relevance and linkages between the ICF and the principles of UD are being actively explored.
- The ICF been used as an important component in developing:
    - A standardised user model for inclusive design;
    - Representations of everyday activities;
    - The Person Environment Interaction Classification (PEIC);
    - Person-object interfaces;
    - The Assessment of Motor and Process Skills (AMPS).
- The ICF is currently being linked to ISO9999 on assistive technology.
- ICF related applications were identified in the design of:
    - Emergency services;
    - Architectural products;
    - ICT applications
    - Computer games;
    - Household products.

Substantial effort has also been expended to ensure that systems and classification which pre-existed the ICF are systematically linked to it including the US Dictionary of Occupational Titles (DOT) which uses the Handbook for Analyzing Jobs and the Matching Person and Technology (MPT) framework.

Although the breadth and depth of the influence of the ICF is undeniable, it was difficult to identify applications which did not require the ICF to be enhanced or augmented by additional and complementary tools or terminologies. Some of these areas can be considered essential to the design of accessible products, services, built environments and information and communication technologies. In particular:

- **Personal Factors**: The fact that the ICF does not provide taxonomy of personal factors is an issue when it comes to design, particularly when specifying user or customer characteristics. While the encoding of personal factors was strongly opposed by disability advocacy groups in the development phase of the ICF, there is little doubt that without a suitable classification of personal characteristics the ICF can’t capture certain key human factors that are essential to UD and design standards.

- **Human-task interactions**: The ICF is essentially a static classification and consequently does not provide a means to code the processing requirements associated with specific tasks. Particular examples of this are:
    - The activity of lifting and carrying objects which is coded in the ICF but not in relation to how far the object must be carried, how heavy the object is or how awkward it is to hold.
    - The task of making a cup of tea which requires the actor to seek, find and assemble all the components for carrying out the task, a processing requirement that can't be coded adequately by the ICF.
- **Environmental factors**: One of the important innovations introduced by the ICF was the acknowledgement of the crucial role that environmental factors play in creating barriers for people with impaired function. However, the approach adopted in classifying the environment is largely descriptive. It tends towards providing a specification of key domains to be considered rather than a detailed analytic framework for application in specific settings or situations. For example, while the ICF specifies that both products and services for general use and assistive products and services need to be taken into account in relation to their impact on a person's level of functioning and participation, it does not provide an analytic framework for specifying how the product or service operates to enable or disable a person. This is an essential step in the UD process and is an area in which the ICF needs to be augmented.
- **Body function, body structure and activity**: The most clearly and comprehensively elaborated components of the ICF relate to body function, body structure and activity. It is in these areas that the ICF is most likely to add value to the design process. Many of the function codes of the ICF correlate with functional consideration in design initiatives such as Keate's and Clarkson's Inclusive Design. Nevertheless, a number of discontinuities have been identified in these codes which would require to be addressed. For example, the way on which 'dexterity' is addressed by the ICF does not reflect its complete scope in human activity.

On the basis that other related resources, which were reviewed for this study, could not be considered to be on their own adequate substitutes for the ICF, the most appropriate approach should be to adopt a combination of the ICF and additional resources. Evidence to support this was found in a number of initiatives that have used the ICF such as AMPS, PEIC, VUMS and have overcome its limitations by adapting it to their needs and augmenting it with other tools and frameworks where required.

Recommendations:

1. An ICF informed framework for UD should be developed which:
    a. Is synchronised across all relevant international design standards,

    b. Integrates appropriate ICF codes into existing definitions and concepts.
2. The ICF should be used in conjunction with appropriate additional related resources, to provide a systematic, clearly specified and linguistically consistent framework and terminology to enhance UD guidance standards.
3. The ICF should be augmented in relation to:
    a. **The specification of personal factors.** This is an area where a substantial amount of work has already been carried out (Gehy, 2011). The latest results of this research should be incorporated into a UD guidance standard,
    b. **The specification of environmental factors.** Work in this area by Sandford and Bruce (2009) with a view to extend ICF environmental component to remedying its shortcomings can form a useful starting point for this. Other initiatives such as Snomed-CT also offer a rich definition of the Environment especially in relation to defining Locations such as Home, Place of Work, Outdoor Space and others. These should also be explored.
    c. **The specification of person-task and person-object interactions**. A number of initiatives are exploring effective approaches to this design requirement. Useful elements and strategies can be adapted from AMPS, PEIC and the Handbook for Analyzing Jobs.
    d. **The specification of anthropometric characteristics**. There is a substantial body of work in this area which can be used to develop appropriate additional design standards including from the field of ergonomics.
4. It is not necessary to adopt the actual terminology of the ICF in order to integrate it into current standards. 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. These rules also provide strategies for documenting concepts not defined in the ICF. An appropriate set of linking rules should be identified and followed.
5. The production of a short list of ICF codes which are most relevant to the domain of UD. should be explored, This could be achieved initially by carrying out a linking procedure to existing design standards including ISO Guide 71 and TR 22411and in the longer term through a consultative process with interested stakeholders and experts.
6. In the immediate term, a number of actions can be implemented to explore the feasibility of integrating the ICF into existing international design standards, to demonstrate the practical advantages of doing this and to identify the challenges in achieving this overall objective. These include:
7. Carrying out a pilot application of the linking rules for the ICF to Guide 71 to explore its relevance and feasibility and to identify gaps and congruities.
8. Revising the current terminology being used in the field of design standards with reference to the ICF.

9. Developing an initial short list of ICF codes which are most relevant to UD.
10. Augmenting the short list with additional elements derived from related resources and current research particularly in relation to personal factors, characterising tasks and activities and processing requirements and specifying environmental factors.
11. Build on current research into the relationship between the principles of UD and the ICF to provide strategy for integrating the ICF into the design of accessible products, services, built environments and information and communication technologies.
12. Coordinate with other international initiatives which are addressing the integration of the ICF into standards e.g. the linking of ICF to assistive technology standards (ISO9999).
13. Develop a guidance document to serve as a basis for international design standards which comply with the principles of UD and to lay out a set of procedures which can be followed to ensure that the ICF is appropriately integrated into the design process.

Annex 1 Description of ICF linking rules

The ICF is a comprehensive set of codes, describing many concepts. It would seem to be a viable representation scheme for the elements of many design and development paradigms. The body structure and function codes can be used to describe a person using a product or service. It has activity codes which can describe the tasks and subtasks involved in using a product or service and finally it has environmental codes which can describe the physical and social domain of use.

Many elements of the Person representation map directly to the ICF. These include Body Structures and Body Functions. There are elements of the ICF to describe Activity and Participation and so on. The ICF also has a number of codes dealing with Environmental Factors

For these reasons, the ICF seems to be a promising basis upon which to represent components of the design process. This requires linking design concepts to the ICF.

Linking concepts to the ICF is typically done through a process of cross-walking from the concept being represented to an appropriate ICF code. The term, 'cross-walking' originated in attempts to map profiling instruments, such as Scherer's MPT to the ICF. [140]

Rules for linking to the ICF were proposed by the ICF monitoring body in 2002[141] and these were upgraded in 2005.[142]

The original 2002 rules were as follows.

a. Before starting the process of linking health-status measures to the ICF categories, identify all meaningful concepts within each item of the health status measure under consideration.

b. The response options of an item are linked if they contain meaningful concepts.

c. The interval of time to which the item refers such as "during the last week" is not linked to the ICF.

d. If a meaningful concept of an item is explained by examples, both the concept and the examples are linked. However, the ICF category to which the examples have been linked will be put within parentheses

These rules were originally 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 linking rules dictate that, for example,

Each meaningful concept is linked to the most precise ICF category.

Not to use other specified or unspecified ICF codes

They introduce new codes such as not definable (nd) and personal factor (pf) to cover gaps in ICF classification.

In more detail the eight rules are:

1. Before one links meaningful concepts to the ICF categories, one should have acquired good knowledge of the conceptual and taxonomical fundaments 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 the lower level category.

5. If the information provided by the meaningful concept is not sufficient for making a decision about the most precise ICF category it should be linked to, the meaningful concept is assigned nd (not definable).

Special cases of this rule:

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 are the linking rules have been effectively used in many studies and offer a strategic basis for mapping concepts to the ICF.[143]

However, while there have been many successful crosswalks to the ICF, linking to the ICF is a difficult process. Issues arise with incomplete matches, loose matches, complex semantic and syntactic inference and much more.[144]

Annex 2 ICF and Related Resources

These are initiatives which pre-date the ICF but which can be described and characterised using the ICF

Systematized Nomenclature of Medicine -- Clinical Terms (SNOMED-CT)

SNOMED CT (Systematized Nomenclature of Medicine--Clinical Terms)[145] is a comprehensive clinical terminology, originally created by the College of American Pathologists (CAP) and, as of April 2007, owned, maintained, and distributed by the International Health Terminology Standards Development Organisation (IHTSDO)[146], a not-for-profit association in Denmark. The CAP continues to support SNOMED CT operations under contract to the IHTSDO and provides SNOMED-related products and services as a licensee of the terminology.

The primary purpose of SNOMED CT is to support the effective clinical recording of data with the aim of improving patient care. SNOMED CT allows a consistent way to index, store, retrieve, and aggregate clinical data across specialties and sites of care. It also helps in organizing the content of medical records, reducing the variability in the way data is captured, encoded and used for clinical care of patients and research. It covers areas such as diseases, symptoms, operations, treatments, devices and drugs.

SNOMED CT Concepts are representational units that categorize all the things that characterize health care processes and need to be recorded. In 2011, SNOMED CT included more than 311,000 concepts, which are uniquely identified by a concept ID, i.e. the concept 22298006 refers to Myocardial infarction.

SNOMED CT concepts are organized around concept groups which organise the concepts into acyclic taxonomic (is-a) hierarchies.

The following is a list of some of the concept groups:

- Body structure (body structure)
- Environment or geographical location (environment / location)
- Event (event)
- Observable entity (observable entity)
- Organism (organism)
- Procedure (procedure)
- Qualifier value (qualifier value)
- Situation with explicit context (situation)
- Social context (social concept)
- Specimen (specimen)

Concepts are further described by various clinical terms or phrases, called Descriptions, which are divided into Fully Specified Names (FSNs), Preferred

Terms (PTs), and Synonyms. Each Concept has exactly one FSN, which is unique across all of SNOMED CT. It has, in addition, exactly one PT, which has been decided by a group of clinicians to be the most common way of expressing the meaning of the concept. It may have no Synonyms or many. Synonyms are additional terms and phrases used to refer to this concept. They do not have to be unique or unambiguous.

SNOMED CT has been linked to the ICF under a recommendation of the US Consolidated Health Informatics (CHI) initiative.[147] This is a collaborative effort to create and adopt health informatics standards to be used by federal departments such as the Department of Health & Human Services (HHS) and the Department of Veterans Affairs. The aim of CHI is a more formal method of information collection and management to ease the transition of the private sector into further interoperability among different health information technology systems.

Standards other than the ICF, which CHI has linked to SNOMED CT, include Health Level 7 International (HL7), the Logical Observation Identifiers Names and Codes (LOINC), Digital Imaging and Communications in Medicine (DICOM)

Linking SNOMED CT to the ICF is not about linking like with like. SNOMED CT defines a class hierarchy which comes with a language, including data type definition which allows for the formal expression of medical concepts, whereas the ICF offers a taxonomic classification of codes.

There are however obvious connection points. Both record body structure, body function, activity and environmental concepts. However these occur at different levels of the class hierarchy in Snomed CT. For example while body structures and environment are top level group concepts, activities occur as a subclass of a subclass of the Observable Entities concept group.

In 2006, under the auspices of CHI[148], Dr Laurence Desi produced tables which form the basis of a mapping from SNOMED CT to the ICF. In these tables ICF codes and their explanations are linked to specific SNOMED-CT codes. For example, the ICF code d640 (doing housework) is linked to the SNOMED-CT code 129014002 (doing housework) which is a subclass of the concept group observable entities (OE).

SNOMED[149] has had a long and distinguished history as a major nomenclature in medical informatics. It looks to consolidate its ontological commitment to providing a formal basis for describing clinical situations[150]. It maintains its commitment to integration with other standards and in this light it is very noteworthy that it should be linked to the ICF.

Handbook for Analysing Jobs (HAJ)

The Handbook for Analysing Jobs (1991) laid out the procedures and criteria used in occupational analysis by Federal and State agencies in the US[151]. The methods were intended to provide the occupational information required in human resource

processes. The HAJ is relevant to any job analysis programme. One significant output of the procedures was the Dictionary of Occupational Titles (DOT) which contained definitions of over13000 occupations.[152]

The Handbook explained the techniques used by the US public employment service to analyse jobs and to present systematic occupational information.

The main components of the HAJ are:

- Worker Functions: That is how an employee must process data, his or her relationship to other people and what must he or she must do to things;
- Work Fields: The methodologies and techniques employed;
- The machines, tools, equipment, and work aids used (MTEWA);
- The materials, products, subject matter, or services which result (MPSMS);
- Worker Characteristics: The worker attributes that contribute to successful job performance.

Job analyses are used in public sector recruitment, selection and replacement; determining physical demands of a job; identifying job adjustments to facilitate workers with disabilities; vocational counselling and job matching; assessing training; and performance appraisal.

For the purpose of this review, the components and elements of the HAJ were mapped onto the ICF. The full analysis of worker functions and worker characteristics is presented in Table 3. The relationship between the HAJ and the ICF was found to be asymmetric. This is to be expected given that their functions are very dissimilar. Worker functions can be considered to be activities using ICF terminology. Any overlaps with the ICF relate to activity and participation (d) codes. However, there is no meaningful or consistent pattern. The more complex worker functions, such synthesising data, mentoring people and precision working, particularly have no equivalent in the ICF.

The majority of worker aptitudes specified within the HAJ have a potential ICF equivalent apart from Clerical Perception. Most of them are related to body function codes (b) but the level of the ICF at which the similarities occur differ. For example, Manual Dexterity can be taken to relate to Manipulating (b4402) and Verbal Aptitude can be mapped to Mental Functions of language (b167).

The majority of HAJ work temperaments are not easily linked to ICF codes. Examples of some temperaments for which there is a potential match include performing a variety of tasks (d220 Undertaking multiple tasks), performing effectively under stress (d240 Handling stress and other psychological demands) and working under specific instruction (d7400 Relating with persons in authority). Others for which no apparent ICF equivalent was found included performing repetitive or short-cycle work, influencing people in their opinions, attitudes, and judgments and working alone or apart in physical isolation from others.

A more consistent relationship could be established between the elements of the HAJ Physical Demands and the ICF. This is presented in Table 1. In some cases there was more than one relevant ICF code such as carrying, transporting an object. In other cases there was a close match between the HAJ and the equivalent ICF code as in the case of Kneeling (d4102 Kneeling), Crouching (d4101 Squatting) and Crawling (d4550 Crawling).

There was no clear equivalence between the HAJ environmental conditions checklist and the ICF. For example, it was not clear what ICF code could be assigned to exposure to weather, extreme cold, extreme heat, wet and/or humid conditions or noise intensity level.

Table 3: The potential overlap between the HAJ Demands Checklist and the ICF

Handbook for Analysing Jobs - Components	ICF Equivalents
Worker Functions	
Data	
0 Synthesizing	Not Specified
1 Coordinating	Not Specified
2 Analysing	Not Specified
3 Compiling	Not Specified
4 Computing	d172 Calculating
5 Copying	d130 Copying
6 Comparing	Not Specified
People	
0 Mentoring	Not Specified
1 Negotiating	Not Specified
2 Instructing	Not Specified
3 Supervising	d7401 Relating with subordinates
4 Diverting	Not Specified

5 Persuading	Not Specified
6 Speaking-Signalling	d330 Speaking d3351 Producing signs and symbols
7 Serving	
8 Taking Instructions – Helping	d7400 Relating with persons in authority d310 Communicating with - receiving - spoken messages d315 Communicating with - receiving - nonverbal messages
Things	
0 Setting Up	Not Specified
1 Precision Working	Not Specified
2 Operating-Controlling	Not Specified
3 Driving-Operating	d475 Driving
4 Manipulating	d4402 Manipulating d440 Fine hand use
5 Tending	Not Specified
6 Feeding-Off Bearing	Not Specified
7 Handling	d449 Carrying, moving and handling objects, other specified and unspecified
Aptitudes	
G - General Learning Ability	b117 Intellectual functions b164 Higher-level cognitive functions d1 CHAPTER 1 learning and applying knowledge
V - Verbal Aptitude	b167 Mental functions of language
N - Numerical Aptitude	b172 Calculation functions

S - Spatial Aptitude	b1565 Visuospatial perception
P - Form Perception	b1561 Visual perception
Q - Clerical Perception	Not Specified
K - Motor Coordination	b176 Mental function of sequencing complex movements
F - Finger Dexterity	d440 Fine hand use
M - Manual Dexterity	d4402 Manipulating
E - Eye-Hand-Foot Coordination	b147 Psychomotor functions
C - Color Discrimination	b21021 Colour vision
Temperament	b126 Temperament and personality functions
D - DIRECTING, controlling, or planning activities of others.	d7401 Relating with subordinates
R - Performing REPETITIVE or short-cycle work.	Not Specified
I - INFLUENCING people in their opinions, attitudes, and judgments.	Not Specified
V - Performing a VARIETY of duties.	d220 Undertaking multiple tasks
E - EXPRESSING personal feelings.	Not Specified
A - Working ALONE or apart in physical isolation from others.	Not Specified
S - Performing effectively under STRESS.	d240 Handling stress and other psychological demands
T - Attaining precise set limits, TOLERANCES, and standards.	Not Specified

U - Working UNDER specific instructions.	d7400 Relating with persons in authority
P - Dealing with PEOPLE.	General interpersonal interactions (d710- d729)
J - Making JUDGMENTS and decisions.	b164 Higher-level cognitive functions
Physical Demands	
Physical Function	
Position	Not Specified
Standing: Remaining on one's feet in an upright position at a workstation without moving about.	d4104 Standing d4154 Maintaining a standing position
Walking: Moving about on foot.	d450 Walking
Sitting: Remaining in a seated position.	d4103 Sitting
Weight/Force	d4153 Maintaining a sitting position
Lifting: Raising or lowering an object from one level to another (includes upward pulling).	d4300 Lifting
Carrying: Transporting an object, usually holding it in the hands or arms or on the shoulder.	d4301 Carrying in the hands d4302 Carrying in the arms d4303 Carrying on shoulders, hip and back
Pushing: Exerting force upon an object so that the object moves away from the force (includes slapping, striking, kicking, and treadle actions).	d4451 Pushing d4451 Pushing
Pulling: Exerting force upon an object so that the object moves toward the force (includes	d4450 Pulling

jerking).	
Controls: Hand-Arm and Foot-Leg	d4453 Turning or twisting the hands or arms
Work intensity	
Sedentary Work: Exerting up to 10 pounds of force occasionally, or a negligible amount of force frequently to lift, carry, push, pull, or move objects, including the human body.	d430 Lifting and carrying objects
Light Work: Exerting up to 20 pounds of force occasionally or up to 10 pounds of force frequently, or a negligible amount of force constantly to move objects.	d430 Lifting and carrying objects
Medium Work: Exerting 20 to 50 pounds of force occasionally, or 10 to 25 pounds of force frequently, or greater than negligible up to 10 pounds of force constantly to move objects.	d430 Lifting and carrying objects
Heavy Work: Exerting 50 to 100 pounds of force occasionally, or 25 to 50 pounds of force frequently, or 10 to 20 pounds of force constantly to move objects.	d430 Lifting and carrying objects
Very Heavy Work: Exerting in excess of 100 pounds of force occasionally, or in excess of 50 pounds of force frequently, or in excess of 20 pounds of force constantly to move objects.	d430 Lifting and carrying objects
Climbing	d4551 Climbing

Balancing	b2351 Vestibular function of balance Changing and maintaining body position (d410-d429)
Stooping	d4105 Bending
Kneeling	d4102 Kneeling
Crouching	d4101 Squatting
Crawling	d4550 Crawling
Reaching	d4452 Reaching
Handling	d440 Fine hand use
Fingering	d4402 Manipulating
Feeling	Additional sensory functions (b250- b279) b265 Touch function
Talking	b310 Voice functions d330 Speaking
Hearing	b230 Hearing functions
Tasting/smelling	b250 Taste function b255 Smell function
Near acuity	b21002 Binocular acuity of near vision
Far acuity	b21000 Binocular acuity of distant vision
Depth perception	b1565 Visuo-spatial perception
Visual accommodation	b215 Functions of structures adjoining the eye
Colour vision	b21021 Colour vision
Field of vision	b2101 Visual field functions
Environmental Conditions	

Exposure to weather	Not Specified
Extreme cold	Not Specified
Extreme heat	Not Specified
Wet and/or humid	Not Specified
Noise intensity level	Not Specified
Vibration	Not Specified
Atmospheric conditions	Not Specified
Proximity to moving mechanical parts	Not Specified
Exposure to electrical shock	Not Specified
Working in high, exposed places	Not Specified
Exposure to radiation	Not Specified
Working with explosives	Not Specified
Exposure to toxic or caustic chemicals	Not Specified

International Encyclopaedia of Rehabilitation

The International Encyclopaedia of Rehabilitation has been developed with joint funding by the US National Institute for Disability and Rehabilitation Research (NIDRR) and the US Department of Education.[153] It is hosted by the Centre for International Rehabilitation Research Information and Exchange (CIRRIE) at the State University of New York in Buffalo. It was developed in collaboration with the Laboratoire d'informatique et de terminologie de la réadaptation et de l'intégation sociale, Laboratory of Informatics and Terminology of Rehabilitation and Social Integration (LITRIS), from the Institut de Réadaptation en Déficience Physique de Québec, Québec Rehabilitation Institute for Physical Disabilities (IRDPQ). The Encyclopaedia is overseen by an international editorial board of 35 members representing all regions of the world.

The Encyclopaedia of Rehabilitation acts as a web-based resource on disability and rehabilitation. It is targeted at researchers, professionals, students, people with

disabilities, and members of the general public. It aims to offer summaries of the state of the art in the field of rehabilitation and disabilities. Topics include information on the primary impairments, programme evaluation, rehabilitation assessment and the physical, psychological, social and environmental aspects of rehabilitation. It is available in English, French and Spanish. The ICF is one of the sources cited by the Encyclopaedia.

There is one entry in the encyclopaedia relating directly to the ICF which used the ICF as a framework to compare the cases of three 24 year old males with mental health difficulties in the US, Canada and India.[154] Another entry applied the ICF to the WHO Disability Assessment Schedule.[155]

The overall approach of the Encyclopaedia as reflected in its topics and themes is essentially about health conditions, rehabilitation and therapeutic interventions and supports. Many of the entries pre-date the publication of the ICF and were produced for the previous version of the Encyclopaedia in 1995 and 1996. The information on health conditions reflects a medical perspective in terms of onset, causes, symptoms and treatment. On this basis it is fair to conclude that it differs substantially in its conception and purpose from the ICF.

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)

CAP - College of American Pathologists

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)

CHI US Consolidated Health Informatics

DICOM Digital Imaging and Communications in Medicine

DOT - Dictionary of Occupational Titles

DTI - UK Department of Trade and Industry

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

ENAT - European Network for Accessible Tourism

HAJ - The Handbook for Analysing Jobs

Hl7 Health Level 7 International Medical Record Electronic Data Interchange Standard

ICF - International Classification of Functioning Disability and Health

ICIDH International Classification of Impairment Disability and Handicap

IHTSDO International Health Terminology Standards Development Organisation

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

IPC- International Paralympic Committee

LOINC - Logical Observation Identifiers Names and Codes

MAP - Measure of Activity and Participation

MAP-EP - Matrix for Analysis of Problems in Educational Planning (MHADIE)

MHADIE- Measuring Health and Disability in Europe

MPT- Matching Person and Technology (Scherer)

MURINET - Multidisciplinary Research Network on Health and Disability in Europe

NPSDD - National Physical and Sensory Disability Database

Participation - involvement in a life situation (ICF)

PEIC - Person Environment Interaction Classification

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)

SERVQUAL – A Conceptual Model of Service Quality

SNOMED CT - Systematized Nomenclature of Medicine--Clinical Terms

UD - Universal Design

UNCRPD - UN Convention on the Rights of Persons with Disabilities

VICON - Visual Impairment and Consumer Products

VUMS - Virtual User Models

W3C - World Wide Web Consortium

WCAG - Web Content Accessibility Guidelines 2.0 (2008)

WHO - World Health Organisation

WHODAS 2.0 WHO Disability Assessment Schedule

WHO-FIC - WHO Collaborating Centre for the Family of International Classifications

References

[1] World Health Organization [WHO] (2002) *International Classification of Functioning, Disability and Health (ICF)*, Available from http://www.who.int/classifications/icf/en/

[2] WHO (2001) International Classification of Functioning, Health and Disability, World Health Organisation, Geneva, Available at: http://www.who.int/classifications/icf/en/

[3] Bruyere, S.M., Van Looy, S.A., & Peterson, D.B. (2005). The International Classification of Functioning, Disability and Health: Contemporary literature overview. *Rehabilitation Psychology*, 50:113–12

[4] American Occupational Therapy Association [AOTA], (2004) Scope of Practice, *American Journal of Occupational Therapy*, 58:673–77

[5] 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

[6] Bruyere, S. M., Van Looy, S.A., & Peterson, D.B. (2005). The International Classification of Functioning, Disability and Health: Contemporary literature overview. *Rehabilitation Psychology*, 50:113–12

[7] Jelsma, J. (2009) Use of the International Classification of Functioning, Disability and Health: A literature survey, *Journal of Rehabilitation Medicine* 41:1–12

[8] 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. Epub 2010 Dec 9. IF: 1.489

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

[10] EuroFound (2012) *Active inclusion for young people with disabilities or health problems*, European Foundation for the Improvement of Living and Working Conditions, Dublin Available at: http://www.eurofound.europa.eu/areas/socialcohesion/illnessdisabilityyoung.htm

[11] Dupré, D. and Karjalainen, A. (2003) Statistics in Focus: Employment of disabled people in Europe in 2002, *Eurostat, Theme 3: population and social*

conditions, Statistical Office of the European Communities, Available at: http://europa.eu.int/comm/eurostat/Public/datashop/print-product/EN?catalogue=Eurostat&product=KS-NK-03-026-__-N-EN&mode=download

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

[13] 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

[14] World Health Survey Instruments and Related Documents Available at: http://www.who.int/healthinfo/survey/instruments/en/index.html

[15] 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

[16] WHO (2010) *Measuring Health and Disability: Manual for WHO Disability Assessment Schedule – WHODAS 2.0*, World Health Organisation, Geneva

[17] Central Statistics Office (CSO) (2008), *National Disability Survey 2006, First Report*, Stationery Office, Dublin Available at: http://www.cso.ie/en/media/csoie/releasespublications/documents/otherreleases/nationaldisability/National%20Disability%20Survey%202006%20First%20Results%20full%20report.pdf

[18] Leonardi, M. *Definition of Disability The contribution of the EU MHADIE project to the international debate* Available at: http://www.mhadie.it/publications.aspx

[19] Multidisciplinary Research Network on Health and Disability in Europe Available at: http://www.murinet.eu/

[20] Govender, T, & Mji, G. (2009) The Profile of grant applications in Bishop Lavis , Cape Town, *South African Family Practice*, 51:228-236

[21] Sanches-Ferreira, M., Simeonsson, R.J., Silveira-Maia, M., Alves, S., et al (2012)Portugal's special education law: implementing the International Classification of Functioning, Disability and Health in policy and practice. *Disability and Rehabilitation* Epub ahead of print

[22] Hollenweger, J. (2011) Development of an ICF-based eligibility procedure for education in Switzerland, *BMC Public Health*; 11(Suppl 4):S7. Published online 2011 May 31

[23] *IPC Handbook December* (2009) Section 2 Chapter 4.4

[24] Tweedy, S.M. & Vanlandewijck, I.Y. (2011) International Paralympic Committee position stand—background and scientific principles of classification in Paralympic sport, *British Journal of Sports Medicine*, 45:259-269 doi:10.1136/bjsm.2009.065060

[25] 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(Suppl 1):S8-S15

[26] de Croon, E.M., Sluiter, J.K., Nijssen, T.F., Dijkmans, B.A.C., Lankhorst, G.J. & Frings-Dresen, M.H.W. (2004) Predictive factors of work disability in rheumatoid arthritis: a systematic literature review, *Annals of Rheumatic Diseases*, 63:1362-1367

[27] Muijzer, A., Geertzen, J.H., Wout, E., de Boer, W.E., Groothoff, J.W., & Brouwer, S. (2012*)* Identifying factors relevant in the assessment of return-to-work efforts in employees on long-term sickness absence due to chronic low back pain: a focus group study, *BMC Public Health*, 12:77. Available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3307027/

[28] Morgell, R., Backlund, L.G., Arrelöv, B., Strender, L. & Nilsson, G.H. (2011) Health problems and disability in long-term sickness absence: ICF coding of medical certificates, *BMC Public Health*. 11:860. Available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3229614/

[29] *Stress Impact*, Available at: http://www.fahs.surrey.ac.uk/stress_impact/

[30] *Optimising strategies for integrating people with disabilities into work*, Available at: http://www2.lse.ac.uk/LSEHealthAndSocialCare/research/PSSRU/pdfs/optiwork.pdf

[31]Wynne, R. & McAnaney, D. (2005) *Employment and disability: Back to work strategies*, European Foundation for the Improvement of Living and Working Conditions, Available at: http://www.eurofound.europa.eu/publications/htmlfiles/ef04115.htm

[32] Simeonsson, R.J., Björck-Åkessön, E. & Lollar, D.J., (2012). Communication, Disability, and the ICF-CY. *Augmentative & Alternative Communication*, 28(1):3–10

[33] Simeonsson, R.J., Simeonsson, N.E. & Hollenweger, J. (2008). International classification of functioning, disability and health: A common language for special education. In L. Florian & M. Mclaughlin (Eds.), *Disability classification in education* (pp. 207–226). New York: Corwin Publishers

[34] Jette, A.M. (2006) Toward a Common Language for Function, Disability, and Health. *Physical Therapy*, 86(5):726–734

Journal of Instructional Technology & Distance Learning, 1(10) [Online]

[35] Seelman, K.D. (2004). Trends in Rehabilitation and Disability: Transition from a Medical Model to an Integrative Model. *Disability World* 22 Available at: http://www.disabilityworld.org/01-03_04/access/rehabtrends.shtml

[36] Chris M. Allan, C.M., Wenonah N. Campbell, W.N., Guptill, C.A., Flora F. Stephenson, F.F. & Karen E. Campbell, K.E. (2006) A conceptual model for interprofessional education: The International Classification of Functioning, Disability and Health (ICF) *Journal of Interprofessional Care*, 20(3):235–245

[37] Belchior, P. (2007) *Cognitive Training with video games to improve driving skills and driving safety among older adults,* PhD Dissertation of the University of Florida, August

[38] 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. Epub 2010 Dec 9. IF: 1.489

[39] Centre for Excellence in Universal Design [CEUD](2009)*Universal design* Available at: http://universaldesign.ie/exploreampdiscover/conferenceproceedings/universaldesignforthe21stcenturyirishampinternationalperspectives/universaldesign Accessed 12.01.2010

[40] Christophersen, J. (Ed.) (2002). *Universal Design. 17 ways of thinking and teaching*. The Norwegian State Housing Bank, Oslo

[41] Hansson L. (2006). *Universal design – a marketable or utopian concept?* Centre for Consumer Science, Göteborg, Available at: http://www.hgu.gu.se/files/fakultetskansli/abstract/hanssonlena.pdf Accessed 15.01.2010

[42] Iwarsson S. & Stahl A. (2003) Accessibility, Usability and universal Design – Positioning and Definition of Concepts Describing Person Environment Relationships, *Disability and Rehabilitation*, 25:57-66

[43] Mace, R. (1997) *What is Universal Design?* Available from http://www.design.ncsu.edu/cud/unive_design/ud.htm Accessed 10.10.2010

[44] http://www.oireachtas.ie/documents/bills28/acts/2005/a1405.pdf

[45] UN Enable (2006) *UN Convention on the Rights of Persons with Disabilities*, Available at: http://www.un.org/disabilities/default.asp?id=150

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

[47] Sangelkar, S. & McAdams, D.A. (2010) Adapting ADA architectural design knowledge to product design: Groundwork for a function based approach, *Proceedings of the ASME, International design engineering Technical Conferences & Computers and Information in Engineering Conference*

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

[49] Sangelkar, S. & McAdams, D.A. (2012) Adapting ADA Architectural Design Knowledge for Universal Product Design Using Association Rule Mining: A Function Based Approach, *Journal of Mechanical Design*, 134(7) Available at: http://asmedl.org/getabs/servlet/GetabsServlet?prog=normal&id=JMDEDB000134000007071003000001&idtype=cvips&gifs=yes&ref=no

[50] Froyen, H., Verdonck, E., De Meester, D., & Heyligen, A. (2009) Mapping and documenting conflicts between Users and Built Environments *Proceedings of Include 2009*

[51] http://www.who.int/classifications/icf/training/icfchecklist.pdf

[52] http://www.veritas-project.eu/vums/

[53] http://veritas-project.eu/?s=variable+table

[54] Sangelkar, S., & McAdams, D.A. (2012) Adapting ADA Architectural Design Knowledge for Universal Product Design Using Association Rule Mining: A Function Based Approach, *Journal of Mechanical Design*. 134:7 Available at: http://asmedl.org/getabs/servlet/GetabsServlet?prog=normal&id=JMDEDB000134000007071003000001&idtype=cvips&gifs=yes&ref=no

[55] 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* Maastricht IOS Press pp1155-1160 September

[56] Macintyre, M., Parry, G. & Angelis, J. (eds.) (2011) *Service Design and Delivery*, New York: Springer ISBN 9781441983206

[57] Humphreys, P.C., Fleming, S. & O'Donnell, O. (1999), *Improving Public Services in Ireland: A Case Study Approach*, CPMR Discussion Paper no. 11, Dublin: IPA.

[58] Hill, P. (1999) Tangibles, intangibles and services: a new taxonomy for the classification of output, *Canadian Journal of Economics*, Canadian Economics Association, 32(2):426-446

[59] England, R. (2011) *Basic Services Management*, Two Hills Publishers.

[60] Bruyere, S.M., Van Looy, S.A., & Peterson, D.B. (2005). The International Classification of Functioning, Disability and Health: Contemporary literature overview. *Rehabilitation Psychology*, 50:113–12

[61] Griffo, G, Leonardi, M., Martinuzzi, A., Francescutti, C., Raggi, A., Kosic, V., & Barbieri, P.V. (2009) Moving towards ICF use for monitoring the UN Convention on the rights of persons with disabilities: the Italian experience, *Disability and Rehabilitation* 31(Suppl 1):S74-S77

[62] ENAT [European Network for Accessible Tourism] (2012) *Draft Business Plan for a CEN Workshop on Guidelines for Universal Design of Tourism Services* Available from http://www.accessibletourism.org accessed 10.8.2012

[63] Douglas, G., Pavey, S., Corcoran, C. & Clements, B.,(2012) Evaluating the use of the ICF as a framework for interviewing people with a visual impairment about their mobility and travel, *British Journal of Visual Impairment*, 30(1):6-21

[64] Chittaro, L., Ranon, R., Carchietti, E., Zampa, A., Biasutti, E., De Marco, L. & Senerchia, A. (2009). A knowledge-based system to support emergency medical services for disabled patients, *Proceedings of the 12th Conference on Artificial Intelligence in Medicine (AIME'09)*, Springer-Verlag, Berlin, pp. 176-180

Chittaro, L., Ranon, R., De Marco, L. & Senerchia, A.(2009) User modelling of disabled persons for generating instructions to medical first responders, *Proceedings of the International Conference on User Modeling, Adaptation, and Personalization (UMAP)*, Springer-Verlag, Berlin, pp. 435-440

Chittaro, L. & Ranon R.(2009) Serious games for training occupants of a building in personal fire safety skills, *Proceedings of VS-GAMES'09: IEEE First International Conference on Games and Virtual Worlds for Serious Applications, IEEE* Computer Society Press, Los Alamitos, CA, USA, pp.76-83

Chittaro, L., & Nadalutti, D. (2009) A Mobile RFID-Based System for Supporting Evacuation of Buildings, *Proceedings of Mobile Response 2008: Second International Workshop on Mobile Information Technology for Emergency Response*, Springer-Verlag, Berlin, pp.22-31

[65] http://www.veritas-project.eu/vums/

[66] http://www.vaalid-project.org/

[67] Geyh, S., C. Peter, R. Müller, J. E. Bickenbach, N. Kostanjsek, B. T. Üstün, G. Stucki and A. Cieza (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

[68] Parasuraman, V.A., Zeithaml, A. & Berry L (1985) A Conceptual Model of Service Quality and Its Implications for the Future Research, *Journal of Marketing* 49:41-50

[69] Schraner, I., de Jonge, D., Layton, N., Bringolf, J. & Molenda, A. (2008) Using the ICF in economic analyses of Assistive Technology systems: Methodological implications of a user standpoint. *Disability and Rehabilitation*, 30(12):916-926

[70] Department of Trade and Industry [DTI] (2000)*A study on the difficulties disabled people have when using everyday consumer products*, Government Consumer Safety Research Department of Trade and Industry, London, UK

[71] 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

[72] Haglund, L. & Henrikkson, C. (2003) Concepts in occupational therapy in relation to the ICF, *Occupational Therapy International*, 10(4):253-268

[73] Keates, S. & Clarkson, P.J. (2004) *Countering design exclusion. An Introduction to inclusive design*, Available from http://www.eng.cam.ac.uk/inclusivedesign/ Accessed 10.10.2011

[74] http://www.veritas-project.eu/vums/

[75] Virtual User Concept for Inclusive Design of Consumer [VICON]Products and User Interfaces, Available fromhttp://www.vicon-project.eu/ Accessed 03.07.2011

[76] RAMSIS Digital Human Model Available from http://www.human-solutions.com/automotive/ramsis_community/index_en.php Accessed 22.07.2011

[77] Jack (2011). *Jack Human Modelling Fact Sheet*, Available from http://www.cardsplmsolutions.nl/media/uploads/downloads/software/Fact_Sheet_Jack.pdf Accessed 22.07.2011

[78] Virtual Humans Available From http://kb.eurovr-association.org/index.php/Virtual_humans Accessed 22.07.2011

[79] Bauer, S.M. (2011) *Integrating Medical, Assistive, and Universal Design Products and Technologies: Assistive Technology Device Classification (ATDC)*, Presentation to the National Disability Authority Dublin 5th Sept. 2011

[80] 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) Summer

[81] Bougie, T., & Heerkens, Y. (2008) *ISO 9999 with ICF References Report* Netherlands Normalisation Institute, May

[82] Scherer, M.J., & Glueckauf, R. (2005) Assessing the benefits of assistive technologies for activities and participation, *Rehabilitation Psychology,* 50:132–141

[83] 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

[84] Brassington, F. & Pettitt, S. (2003) *Principles of Marketing, 3rd ed.*, Prentice-Hall/Financial Times, Englewood Cliffs, NJ

[85] Lightner, N.J. and Eastman, C. (2002) User preference for product information in remote purchase environments, *Journal of Electronic Commerce Research*, 3(3):174-86

Lin, Z., Hu, X. and Zhang, H. (2001) Myth or reality? Effect of trust promoting seals in electronic markets, Presented at *WITS*, New Orleans, LA, USA

[86] 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*

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

Mpofu E & Okland T (eds) *Rehabilitation and Health Assessment: Applying ICF guidelines,* Springer New York 2009 pp.207-228

[88] Bruce, C.M. & Walker, B.N. (2009) Developing Effective Real-time Audio Interpretation to Enhance Accessibility of Dynamic Zoo and Aquaria Exhibits, *Proceedings of the Association for the Advancement of Assistive Technology in Europe Conference (AAATE 2009),* Florence, Italy

[89] Jørgensen, U., Melchiorsen, H., Gottlieb, A.G., Hallas, V. & Nielsen, C.V.(2010) Using the International Classification of Functioning, Disability and Health (ICF) to describe the functioning of traumatised refugees. *Torture,* 20(2):57-75

[90] Fisher, A.G., & Bray Jones, K. (2010) *Assessment of Motor and Process Skills. Vol. 1 and 2: Development, Standardization, and Administration Manual (7th ed.),* Fort Collins, CO: Three Star Press

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

[92] Scherer, M.J. (1998) *Matching person with technology and accompanying assessment instruments*, Matching Person with Technology Institute, Webster, NY

[93] Scherer, M.J. (ed) (2002) *Assistive Technology: Matching Device and Consumer for Successful Rehabilitation*. Washington, DC: APA Books. ISBN 1-557-98840-4

[94] Keates, S. & Clarkson, P.J. (2004) *Countering design exclusion. An Introduction to inclusive design* Available from http://www.eng.cam.ac.uk/inclusivedesign/ Accessed 10.10.2011

[95] http://store.sae.org/caesar/

[96] *Inclusive Design Toolkit* http://www.inclusivedesigntoolkit.com/betterdesign2/exclusioncalc/exclusioncalc.html

[97] Department of Trade and Industry [DTI] (2000)*A study on the difficulties disabled people have when using everyday consumer products*, Government Consumer Safety Research Department of Trade and Industry, London, UK

[98] Badler, N., Ramamani, I., Bindiganavale, N., Allbeck, J.M., Schuler W., Zhao, L., & Palmer, M. (2000) Parameterized Action Representation for Virtual Human

Agents, In *Embodied Conversational Agents*, J. Cassell, J. Sullivan, S. Prevost and E. Churchill (Eds.), MIT Press, pp256-284

[99] Veitch, J.A., &. Newsham, G.R. (1997) Lighting Quality and Energy-Efficiency Effects on Task Performance, Mood, Health, Satisfaction and Comfort, Illuminating Engineering Society of North America, IESNA Conference, Paper # 47 *Journal of the Illuminating Engineering Society* Seattle, WA, August

[100] Tversky, B. (2004) Narratives of space, time, and life, *Mind and Language*, 19:380-392

[101] Shove, E., Watson, M., Hand, M. & Ingram, J. (2007) The Design of Everyday Life, Berg Publishers

[102] Scherer, M.J. (2003). Connecting to Learn, Educational and Assistive Technology for people with Disabilities, Presentation to the *American Psychological Association*

[103] Badler, N. (1997). Virtual Humans for Animation, Ergonomics and Simulation, *IEEE Workshop on non-rigid and Articulated Motion* Puerto Rico

[104] Kallmann, M. & Thallmann, D.(1998) Modeling Objects for Interaction Tasks, *Proceedings of the 9th Eurographics Workshop on Animation and Simulation* EGCAS Lisbon Portugal

[105] Gibson, J.J. (1977) The theory of affordances, In R. Shaw & J.Brandsford (eds.), *Perceiving, Acting and Knowing*, Hillsdale, NJ Erlbaum

[106] National Kitchen and Bathroom Association [NKBA] (2009) Available from www.NKBA.org Accessed 10.01.2009

[107] Chen, M.D. (2005) *Serious Games: Games that Educate, Train and Inform*, Thomson Course Technology

[108] MacNamee, B., Rooney, P., Lindstrom, P., Ritchie, A., Boylan, F. & Burke, G. (2006), Serious Gordon: Using Serious Games to Teach Food Safety in the Kitchen, In *Proceedings of the 9th International Conference on Computer Games: AI, Animation, Mobile, Educational & Serious Games* CGAMES06

[109] Scherer, M.J. & Glueckauf, R. (2005) Assessing the benefits of assistive technologies for activities and participation, *Rehabilitation Psychology,* 50:132–141

[110] http://www.washington.edu/doit/Brochures/Academics/instruction.html

[111] US Department of Labour (1991)*The Revised Handbook for Analyzing Jobs* Available at: http://wdr.doleta.gov/opr/fulltext/document.cfm?docn=87

[112] US Departmetn of Labour (1991) *Dictionary of Occupational Titles*, Available at: http://www.occupationalinfo.org/

[113] Barros-Bailey, M. (2009) *Content model and classification recommendations for the Social Security Administration Occupational Information system*, Report to the Commissioner of Social Security Available at: http://ssa.gov/oidap/Documents/Occupational%20Information%20Development%20Advisory%20Panel.pdf

[114] Openshaw, S. & Taylor, E.(2006) *Ergonomics and Design A Reference Guide*, Allsteel Inc Available at: www.allsteeloffice.com/ergo accessed 10.9.2010

[115] ISO (2011) *Ergonomics – General approach, principle and concepts*, ISO26800:2011(E), International Standards Organisation, Geneva

[116] Leyshon, R.T. & Shaw, L.E. (2008) Using the ICF as a conceptual framework to guide ergonomic intervention in occupational rehabilitation, *Work*, 31(1):47-61

[117] Dunn, W., Brown, C. & McGuigan, A. (1994) The Ecology of Human Performance: A framework for considering the effect of context. *American Journal of Occupational Therapy* 48:595-607

[118] WHO (2002) *ICF Beginners Guide*, World Health Organisation, Geneva. Available at: http://www.who.int/classifications/icf/training/icfbeginnersguide.pdf accessed 4.9.2012

[119] Reed, K., & Sanderson, S.R. (1983) *Concepts of occupational therapy (2nd ed.)*, Baltimore: Williams & Wilkins

[120] Kielhofner, G. (2008).*A Model of Human Occupation: Theory and Application (4th ed)*, Baltimore Williams & Wilkins 2008

[121] Hagedorn, R. (1992) *Occupational therapy: foundations for practice*, London: Churchill Livingstone, Sen University of Medical Sciences, Guangzhou, PRC

[122] Tweedy, S. (2009) *IPC Athletics Classification Project for Physical Impairments: Final Report – Stage 1* Submitted May Available at: http://www.paralympic.org/sites/default/files/document/120725114512622_2010_07_16_Stage_1-Classification_Project_Final_report__for_2012_forward.pdf

[123] Australian Institute of Health and Welfare (AIHW) (2003) ICF Australian User Guide. Version 1.0. *Disability Series*, AIHW Cat. No. DIS 33. Canberra: AIHW

[124] Letter to the Editor from Stephen Wilson: influence of the international classification of functioning, disability and health on Paralympic sports classification, *Journal of Rehabilitation Medicine*, 41:1104

[125] Gilligan, J. & Smith, P. (2009).Modeling Assistive Technology Systems using Coloured Petri Nets, In *Assistive Technology From Adapted Equipment to Inclusive Environments*, AAATE Conference Florence Italy IOS Press pp 754-760,September

[126] Scherer, M.J. & Glueckauf, R.:(2005). Assessing the benefits of assistive technologies for activities and participation, *Rehabilitation Psychology*, 50:132–141

[127] 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, *Journal of Rehabilitation Medicine* 34:205–210

[128] Cieza, A., Geyh, S., Chatterji, S., Kostanjsek, N., Ustun, B. & Stucki, G.(2005) ICF Linking rules an update based on lessons learned, *Journal of Rehabilitation Medicine*, 37:212–218

[129] UN Enable (2006) *UN Convention on the Rights of Persons with Disabilities*, Available at: http://www.un.org/disabilities/default.asp?id=150

[130] Barnes, C. (2011) Understanding Disability and the Importance of Design for All, *Journal of Accessibility and Design for All*, 1(1):54-79

[131] Yu, J. (2011) Carrying Objects: Tech Sheet, Centre for Universal Design Archives, *Design Research and Methods Journal* 1(1) Available From http://design-dev.ncsu.edu/openjournal/index.php/redlab/issue/view/5 Accessed 22.07.2011

[132] Chittaro, L., & Ranon, R.(2009). Serious games for training occupants of a building in personal fire safety skills, *Proceedings of VS-GAMES'09: IEEE First International Conference on Games and Virtual Worlds for Serious Applications*, IEEE Computer Society Press, Los Alamitos, CA, USA, March 2009, pp76-83

[133] 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

[134] Fisher, A.G. & Bray Jones, K. (2010) *Assessment of Motor and Process Skills. Vol. 1 and 2: Development, Standardization, and Administration Manual (7th ed.)*, Fort Collins, CO: Three Star Press

[135] Clarkson, P.J. Coleman, R., Hosking, I. & Waller S. (2007) *Inclusive Design Toolkit*, Cambridge Engineering Design Centre ISBN 978-0-9545243-2-6

[136] Gilligan, J. & Smith, P. (2011) Adapting Linking Rules to the International Classification of Functioning as a method for Representing Assistive Technology Knowledge, *Everyday Technology for Independence and Care AAATE 2011* Maastricht IOS Press pp.1155-1160 September

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

[138] Scherer, M.J.(2003). Connecting to Learn, Educational and Assistive Technology for People with Disabilities, Presented at the *American Psychological Association*

[139] 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. Epub 2010 Dec 9. IF: 1.489

[140] Scherer, M.J. & Glueckauf, R.:(2005). Assessing the benefits of assistive technologies for activities and participation, *Rehabilitation Psychology*, 50:132–141

[141] 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, *Journal of Rehabilitation Medicine* 34:205–210

[142] Cieza, A., Geyh, S., Chatterji, S., Kostanjsek, N., Ustun, B. & Stucki, G.(2005) ICF Linking rules an update based on lessons learned, *Journal of Rehabilitation Medicine*, 37:212–218

[143] Oltman, R., Neises, G., Scheible, D., Mehrtens, G. & 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 at: http://www.biomedcentral.com/1471-2474/9/13

[144] 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

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

[146] http://www.ihtsdo.org

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

[148] http://www.ncvhs.hhs.gov/061011p2b.pdf

[149] Cornet, R. & de Keizer, N. (2008) Forty years of SNOMED: a literature review, *BMC Medical Informatics and Decision Making* 8:S2 PMID 19007439.

[150] Schulz, S., Cornet, R. & Spackman, K. Consolidating SNOMED CT's ontological commitment, *Applied Ontology*, 6:1-11.

[151] US Department of Labour (1991) *The Revised Handbook for Analyzing Jobs* Available at: http://wdr.doleta.gov/opr/fulltext/document.cfm?docn=87

[152] US Department of Labour (1991) *Dictionary of Occupational Titles*, Available at: http://www.occupationalinfo.org/

[153] Blouin, M. & Stone, J. (eds) (2012) International Encyclopaedia of Rehabilitation, Available at: http://cirrie.buffalo.edu/encyclopedia/ Accessed 19-09-12

[154] Vroman, K. & Arthanat, S. (2010) ICF and Mental Functions: applied to Cross Cultural Case Studies of Schizophrenia, In: J.H. Stone and M. Blouin, (eds) *International Encyclopaedia of Rehabilitation*. Available online: http://cirrie.buffalo.edu/encyclopedia/pdf/en/icf_and_mental_functions_applied_to_cross_cultural_case_studies_of_schizophrenia.pdf

[155] Frederici, S. & Meloni, F. (2012) WHODAS II: Disability self-evaluation in the ICF conceptual frame, In: JH Stone, M Blouin, (eds) *International Encyclopaedia of Rehabilitation* Available online: http://cirrie.buffalo.edu/encyclopedia/en/article/299/