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TECHNICAL REPORT

Human Factors (HF);
Access to ICT by young people: issues and guidelines

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Human Factors (HF).

Modal verbs terminology

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Introduction

The majority of children in 19 European countries report using their smartphones 'daily' or 'almost all the time' from the EU Kids Online 2020 survey [i.55]. Among many other findings, the survey shows that the time children now spend online varies between about two hours per day (Switzerland) and three-and-a-half hours (Norway). Children are generally overlooked when considering ICT accessibility requirements. It is assumed that childhood is a temporary impairment that will vanish as the body and mind mature, and that special attention to the requirements of children is wasted effort. Accessibility for All thereby becomes Accessibility for Adults. Alternatively, it is assumed that children are "Masters of Technology" who are far superior to adults and have an inexplicable, innate ability to understand the inner workings of ICT and put it to constructive use. The present document confronts both of these assumptions, uncovering various myths associated with children and ICT use, replacing them with empirical findings and specific concerns recently expressed in public debate. Children (18 years and younger) are becoming an increasingly significant consumer group for advanced computing and communications services. In some cases, children as young as four or younger are using ICT products. These products are often embedded in or "disguised" as toys, but far too often they are designed for the generic user, i.e. adults. Children are expected to use equipment designed for adults that has inappropriate physical and cognitive ergonomics for their needs. The accessibility requirements for participation in ICT of this group are not currently clearly identified or catered for, partly because no developmental account of physical, cognitive, and social maturation that can be readily applied to product design exists. If not adequately considered this may result in problems such as inability to access services, service abuse, online vulnerability to exploitation, failures in the growth of relevant cognitive skills and physical damage from prolonged use of systems with inappropriate or inadequate physical terminal design. Public anxiety and awareness of issues related to exclusion are high. Users are almost daily confronted with examples of how poorly designed products and services - especially automated services - exclude and disenfranchise significant proportions of the general population, particularly, but not limited to, the elderly and people with physical and cognitive impairments. What is often overlooked, however, is that children's daily encounters with technology encompass much more than smartphones, gaming devices, smart TVs and vending machines. The home and school are rapidly being transformed - for better or worse - into sites of a globally connected multimedia culture, integrating a wide variety of audiovisual, information and telecommunications products and services that children are expected to use. Children increasingly depend on the PC, Internet and smartphones to achieve their educational goals, be entertained and interact with friends and family. As Sonia Livingstone [i.10] has pointed out, electronic media are extending their influence throughout children's lives to the extent that children's leisure can no longer be separated from their education, their employment prospects, or their participation in the civic or private family arena. Accessibility thus becomes not merely a design objective, but an issue of central importance within the field of children's rights. The right to protection from harmful influences, abuse and exploitation, and the right to participate fully in family, cultural and social life as specified in the UN Convention on the Rights of the Child [i.7] are all directly linked to the ICT accessibility issues described in the present document. The link will become increasingly more important as society and our children become more and more reliant on ICT to fulfil their basic needs. The present document reviews the human interaction issues for access to Information and Communications Technology (ICT) by children and guides how these should be dealt with by ETSI. This will include the ethical issues of security for vulnerable children accessing public communications spaces often in the form of social media and instant messaging services or apps.

1 Scope

The present document reviews the human interaction issues for access to Information and Communications Technology (ICT) by children and provides guidance on how these should be dealt with by ETSI. This will also include the ethical and legal issues of security for vulnerable children accessing public communications spaces.

The present document identifies key issues, and potential solutions, and makes recommendations to ETSI for the specific actions that need to be taken in this area. Where possible this is supported by examples. Relevant issues have been identified and selected on the basis of consultations with stakeholders and industry representatives, a review of existing empirical studies and anecdotal accounts of ICT use by children as presented in popular media.

The present document emphasizes opportunities for simple generic solutions that are commercially attractive to network operators and equipment providers for delivery as a sustainable revenue-generating activity, which opens information and communications technologies to consumers who might otherwise be excluded.

The present document explores key issues in relation to child development (physical, social and cognitive). Although the scope of the present document is limited to "normal" child development, the approach described in clause 5 can also be used to uncover and describe the requirements of user groups with special needs, e.g. developmentally impaired or delayed children. Contextual issues (ethical, legal, sociocultural) of children are highlighted.

The present document reviews current initiatives within and outside Europe promoting ICT usage by children.

The present document presents the various interactions involved in children's use of ICT within a structured framework consisting of five aspects or parameters of technology use, allowing each aspect to be exposed in a systematic manner. An example of how this framework can be applied is presented.

Version two of the present document updates and expands ETSI TR 102 133 [i.41] Access to ICT by Young People: issues and guidelines. This includes extending the age range of the document from under 12 to 18. As at the moment there is inconsistency between companies and services in how they treat minors. Generally, in law, a minor is someone under a certain age, usually the age of majority, which demarcates an underage individual from legal adulthood. It ncorporates relevant legislation and regulations which has been introduced since the TR was originally published, the design best practices that have emerged since the original publication and update the ones already discussed, as well as the research that has been done since the original publication.

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long-term validity.

The following referenced documents may be useful in implementing an ETSI deliverable or add to the reader's understanding, but are not required for conformance to the present document.

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[i.26] The Guardian: "Kids are on their phones more than ever. We asked parents what they're doing about it", 2024.

[i.27] Federal Communications Commission: "Children's Internet Protection Act (CIPA)", 2024.

[i.28] Guidance Online Safety Act: explainer.

[i.29] European Commission: "The Digital Services Act".

[i.30] European Union Agency For Fundamental Rights: "Handbook on European data protection law"; pages 149 - 150; 2018 edition.

[i.31] European Commission: "A European strategy for a better internet for kids (BIK+)", 2022.

[i.32] getsafeonline: "Guide to ISP filters and web blocking".

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[i.39] Childnet: "Resources for all".

[i.40] ICO: "Protecting children's privacy online: Our Children's code strategy".

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[i.42] ETSI TR 104 077-1: "Human Factors (HF); Age Verification Pre-Standardization Study; Part 1: Stakeholder Requirements".

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[i.45] ETSI TR 101 550: "Documents relevant to EN 301 549 (V1.1.1) Accessibility requirements suitable for public procurement of ICT products and services in Europe".

[i.46] ETSI TR 103 349: "Human Factors (HF); Functional needs of people with cognitive disabilities when using mobile ICT devices for an improved user experience in mobile ICT devices".

[i.47] ETSI EG 203 350: "Human Factors (HF); Guidelines for the design of mobile ICT devices and their related applications for people with cognitive disabilities".

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[i.49] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation).

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[i.54] ETSI EN 301 549 (V3.2.1) (2021-03): "Harmonised European Standard; Accessibility requirements for ICT products and services".

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[i.56] Regulation (EU) 2024/2847 of the European Parliament and of the Council of 23 October 2024 on horizontal cybersecurity requirements for products with digital elements and amending Regulations (EU) No 168/2013 and (EU) 2019/1020 and Directive (EU) 2020/1828 (Cyber Resilience Act).

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the following terms apply:

apprenticeship: model of learning, in which knowledge is acquired in the process of performing

apps: short for application software, which is a type of computer program that performs a specific personal, educational, and business function and where each application is designed to assist end-users in accomplishing a variety of tasks, which may be related to productivity, creativity, or communication

banner: coloured, horizontal bar with a title and optional graphic elements displayed on a portal page

browsing: moving from place to place on the Internet searching for topics of interest

chat room: virtual room on the Internet where real-time communication between two or more users takes place via computer

child development: process that turns infants into adults, including changes in size and shape, in knowledge and reasoning ability, in physical and social skills, etc.

clickstream: sequence of navigational data or usage information

comprehension: according to the communication theory, process that involves not only decoding messages, but also making additional inferences about meaning

cookies: files that log every site visited by the user

edutainment: computerized entertainment comprising both education and entertainment

icon: small picture displayed on the screen that depicts a task that can be invoked by clicking with the mouse

informercialization: integration of advertisements and programmes

internet: global network of computers

microtargeting: designing personalized advertising aimed at individual users

multimedia: combination of media types including text, graphics, animation, audio and video

multi-user domain: cyberspace where users can interact with one another

one-to-one marketing: interactive relationships between seller and purchaser

portal: set of information-content areas, pages, applications, even data from outside sources-brought together in one central location and accessed through a common interface, called a page

scaffolding: support platform allowing novices to enter a situation sufficiently to learn not only how to reproduce the activity but also the content that is embedded in the activity

software: series of computer instructions or data that can be stored electronically

spokes characters: fictional cartoons animated characters

surfing: see browsing

Worldwide Web (WWW): hyperlinked text- and graphic-based part of the Internet

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

3GPP	3rd Generation Partnership Project
AD	Advertisement
AI	Artificial Intelligence
ANEC	European Association for the Coordination of Consumer Representation in Standardisation
ATM	Automatic Teller Machine
BECTA	British Educational Communications and Technology Agency
BIK	Better Internet for Kids
CD-ROM	Compact Disk - Read-Only Memory
CEN	European Committee for Standardization
CIPA	Children's Internet Protection Act
COPPA	Children's Online Privacy Protection Act
CRA	Cyber Resilience Act
DPO	Data Protection Officer
DSA	Digital Services Act
EEA	European Economic Area
EG	ETSI Guide
EKATO	Hellenic Consumer Association of Florina
E-mail	Electronic mail (messages exchanged via computer)
EN	European Norm
EU	European Union
EU/EC	European Union/European Commission
FCC	Federal Communications Commission
GDPR	General Data Protection Regulation
HCI	Human-Computer Interaction
HF	Human Factors
ICRA	Internet Content Rating Association
ICT	Information & Communication Technology
ISBN	International Standard Book Number
ISO	International Organization for Standardization
ISP	Internet Service Provider
ISSS	International Society for the Systems Sciences
MR/AR	Mix Reality / Augmented Reality
NIS2	Network and Information Systems directive 2
PAID	Purchasing, Accepting, Invoicing, Disbursing
PC	Personal Computer
RDF	Resource Description Framework
RF	Radio Frequency
RF-EMR	RadioFrequency ElectroMagnetic Radiation
RSS	Really Simple Syndication
SMS	Short Message System
TC	Technical Committee
TR	Technical Report
TV	Television
UI	User Interface
UK	United Kingdom
UN	United Nations
UNCRC	United Nations Convention on the Rights of the Child
UNICEF	United Nations International Children's Emergency Fund

US	United States
USA	United States of America
VLOP	Very Large Online Platform
VLOS	Very Large Online Search
WWRF	Wireless World Research Forum
WWW	World Wide Web

4 The evolution of children and their ICT user requirements

4.0 Introduction

Children, as ICT users, are in most aspects differently abled than adults. Only if their abilities, needs and requirements are studied, understood and differentiated, can well-working, understandable and accessible ICT solutions be offered.

Our challenge in providing guidance on designing for children is complex, because depending on the definition of "children", our interfaces may or may not be supportive of their relevant cognitive, social, or physical skills and capabilities at a certain stage.

Any "Design for all" approach should include the youngest users, if and where they are part of the targeted user group, differentiating abilities and requirements. This is "design for all" for children can also be relevant for adults with lifelong physical and/or neurodevelopmental conditions.

4.1 Key theories of child development

An overview of the key theories and characteristics of child development is provided in this clause in three main areas:

- physical growth;
- cognitive maturation; and
- social development is discussed in chronological order.

The focus is on the typical development of the normal child.

Our selection criteria for the approaches and sources considered in the selection process was guided by balance, trying to include several major ideas bearing on important topics and agreement, conveying important facts and ideas on which researchers seem to have agreed, forming a sort of generic, common knowledge base.

Human development is the process that turns babies into children, children into adolescents, adolescents into young Adults and young adults into, into mature adults then old people. Nature is in no hurry at all human infants are more dependent on other's care than are the young of any other species. also, childhood spans far longer, allowing for step-by-step physical and mental development. for the present work, it focuses on child development from birth to adolescence.

Once a child is born, the environment expands tremendously. the most important basic aspect, the family, is only the beginning. the environment includes many other factors, affecting a child's development, such as cultural differences, the socio-economic level and heredity. The interaction between heredity and environment and their importance in shaping a child's intelligence, personality and sociability has been studied intensely. scientists agree that children are shaped by their heredity and environment, but it is not agreed or clear how much is inherited and how much results from environmental influences.

Child development can be studied in different ways:

- Descriptive studies based on representative samples, allowing for conclusions about the mean and variability.
- Correlational studies are designed to investigate existing relationships between two or more sets of related data.

- Experimental methods, concluding upon the significance of differences from data collected in experiments.

As there are a large number of theories and approaches describing child development, the present document has applied the selection criteria of balance and agreement, trying to include most major ideas on important topics, conveying important facts and ideas on which researchers have agreed.

Research of child development began in the late 1880s, when G. Stanley Hall tried to understand how children's beliefs changed and their knowledge increased, as they grew older [i.13]. Some 20 years later, Alfred Binet tested schoolchildren in Paris, in order to identify those who required more assistance. at about the same time, Sigmund Freud began to develop his theories on the human mind and personality [i.14].

Until the last century, childhood was not viewed as a special time of life: children were seen simply as miniature adults, assuming babies were born with their minds already "pre-programmed" with certain content. This was later denied by John Locke believing in an empty baby mind, a "tabula rasa" [i.15], until filled and shaped by thought knowledge and the environment.

Jean-Jacques Rousseau's theory [i.13] was based on that children are capable individuals to be left alone in order to develop naturally. Charles Darwin, assuming even humans are animals [i.16], subject to the same "laws of nature" that control an animal's responses, believed in instincts - inherited patterns of behaviour.

Maria Montessori, in the early 1900s, stressed in her pedagogical methodology the need for training of the senses with unrestricted liberty [i.17], also introducing a new methodology of teaching children to write.

Sigmund Freud, the founder of psychoanalysis, argued that problems of sexual origin acquired during childhood experiences account for most adult psychological problems. Dividing the human mind into the id, the ego and the superego, he offered the first real-stage theory of development. Stage theories are characterized by stages coming in a certain order but at various speeds. Also, what goes on in the stages is discrete and qualitatively different from what goes on in other stages. Freud's five development stages [i.14] are the oral, anal, phallic, latency and genital stages.

Erik Eriksson developed a more complex psychosocial stage theory [i.18], covering all phases of a human's life. The emphasis is on social interaction, less on sexual matters. The stages relevant to child development are trust versus mistrust, autonomy versus shame and doubt, initiative versus guilt, ego growth, and industry versus inferiority followed by the identity crisis in adolescence. The last three stages, occurring in adulthood, are not relevant to this work.

Jean Piaget was interested in cognitive development, the growth of knowledge and understanding [i.19], [i.23]. In his view, children actively seek information, achieving knowledge through their efforts, as a result of the highest possible level of biological adaptation. Their built-in driver is one of the main characteristics of a human being.

Lawrence Kohlberg, focusing on the development of moral reasoning [i.20], defined three stages: on the pre-conventional level, moral reasoning is only about the possibility of success and failure, defined as "getting caught". Conventional reasoning is based upon society's rules, while post-conventional reasoning considers personal principles to be more important than upholding society's conventions and rules, a level most people never reach.

Behaviourists like J.B. Watson [i.21] and B.F. Skinner [i.22], focusing on the child's practical response and not thoughts or feelings, believed in conditional fear, classical and operand conditioning shaping our behaviour.

Adolescence is a period of significant development that begins with the onset of puberty and ends in the mid-20s. Consider how different a person is at the age of 12 from the person he, she or they are at age 24. The trajectory between those two ages involves a profound amount of change in all domains of development - biological, cognitive, psychosocial, and emotional [i.24].

Importantly, although the developmental plasticity that characterizes the period makes adolescents malleable, malleability is not synonymous with passivity. Indeed, adolescents are increasingly active agents in their developmental process. Yet, as they explore, experiment, and learn, they still require scaffolding and support, including environments that bolster opportunities to thrive. A toxic environment makes healthy adolescent development challenging. Ultimately, the transformations in body, brain, and behaviour that occur during adolescence interact with each other and with the environment to shape pathways to adulthood.

While often thought of as a time of turmoil and risk for young people, adolescence can be viewed as a developmental period rich with opportunities for youth to learn and grow. If provided with the proper support and protection, normal processes of growth and maturation can lead youth to form healthy relationships with their peers and families, develop a sense of identity and self, and experience enriching and memorable engagements with the world. Adolescence thus forms a critical bridge between childhood and adulthood and is a critical window of opportunity for positive, life-altering development.

All these theories of child development, briefly outlined through their main characteristics, are not necessarily incompatible - they are pictures of a developing human, looked at from different angles, all providing a view - if not the whole and ultimate.

4.2 Key aspects of physical growth, cognitive maturation, perceptual and social development

4.2.0 Introduction

The embryological development is a progressive process of anatomical differentiation, which also applies to the development of behaviour. Some aspects of the orderly progression of development are determined by maturation, genetically pre-programmed, independent of specific environmental conditions (e.g. walking).

Children's physical size and development are one of the basic obstacles to the convenient use of ICT devices and services. Typically, children will have their first user experience with a parent's computer, tablet, smartphone, etc. designed and sized for adult users.

4.2.1 0-2 years

Noteworthy characteristics of newborn children are their small size, different body proportions and need to associate with other people in order to survive. The rate of growth will initially be high to later slow considerably. Sex differences can be observed, with girls achieving more than half of their adult height by the age of two.

The brain of a newborn is only a quarter of the size of an adult brain. During the first six months of life, myelination to the parietal cortex introduces new spatial awareness abilities, although the ability to reason about spatial relationships is not functional. Development in the cortex provides abilities to handle specific senses and motor functions.

The newborn baby is not a remarkably sociable person, being in a receptive state for only very short periods, when not sleeping, crying or being fed. Basic behaviours are looking, vocalizing/talking and facial expressions with strong bands developed with the parents. This relationship develops into attachment, a remarkably universal aspect of development.

Many functional parts of the brain are formed in the womb but are not functional at birth. Many clauses, including the cerebral cortex, have billions of neurons as internal connections. These neurons do not have the myelin sheath required for them to carry signals and are therefore not functional. Many new neuron connections are made as the brain grows.

Unless these are subsequently exercised, they cease to function and die off. Baby brains also have an ability lost later in life - unusual sensory linkages, essential attributes of the infant brain that enable them to be "extra" aware of external stimuli.

During the second half year of life, the frontal lobe begins to become active giving the initial cognition and reasoning abilities. These are, however, very primitive, and function at the level of choosing to take one of two objects rather than grabbing both. This coincides with the development of motor control skills leading to walking. Memory begins to influence a child's behaviour.

Between 12 and 18 months of age, toddlerhood begins with the child beginning to walk. In the meantime, the Wernicke language area begins to function, giving the child the ability to hear language as language, and to begin to understand it.

Toddlerhood is also the time when socialization begins, the child begins to learn attitudes, behaviours, knowledge and skills necessary to get along in society.

Between 18 and 24 months, the Broca language area [i.13] begins to function, providing the child with the ability to produce language. Also, children get a sense of themselves and the ability to recognize themselves in a mirror develops.

Piaget's first stage of cognitive development takes place, the sensory-motor period, allowing object performance to develop. Children during this period do not have object permanence - "Out of sight, out of mind" is a well-known, related phrase.

4.2.2 2-5 years

The pre-school period begins. Breathing becomes slower and deeper and physical health improves. Motor patterns and skills -sequences of precise movements -and manipulation develop. The various motor and sensor control areas of the

brain start to correlate and work together. Visual constancies, and pro-social behaviour but also aggression develop. The average vocabulary grows to 200 to 300 words by the age of 2, increasing to about 2 500 words in the productive and 15 000 in the receptive vocabulary at the age of 6. Grammatical morphemes develop, together with the first questions, negatives and tag questions.

During Piaget's preoperational period, between 2 and 7 years of age, thought is egocentric and single aspects of a problem, the "centre", are focused. During this stage, children build on object permanence and continue to develop abstract mental processes. This means they can think about things beyond the physical world, such as things that happened in the past.

The child develops the ability to conceptualize abstract thought as an extension of the "reality" that they are experiencing.

4.2.3 5-11 years

Between 5 to 12, middle childhood, children extend their abstract thinking ability to include concepts such as the past and future and begin to be able to have the ability to see things from the perspective of another person. During this time, they begin to mentalize (also called theory of mind) is the ability to explain, predict, and interpret behaviour by attributing mental states such as desires, beliefs, intentions and emotions to oneself and other people [i.25].

Growth is relatively slow, but strength develops considerably. The ability to integrate fine motor skills with perceptual skills, such as the coordination of the eyes and hands, begins to operate at this age as a small but vital part of the parietal lobe begins to operate.

The smooth transition to the period of concrete operations (seven to eleven years) takes place. The child's understanding is tied to real, concrete, "touchable" objects. They cannot think in abstract, logical terms before they enter the period of formal operations (eleven and on).

There is a steady and considerable increase in meta-cognitive knowledge and understanding and use of strategies involved in learning, memory and information processing. Selective attention, the ability to focus attention on specific things, grows during the school years.

The child learns to read, an important prerequisite to later acquisition of knowledge. Learning difficulties, e.g. dyslexia and hyperactivity, can seriously impact children's achievement at school. There are now apps and digital tools which have been designed to aid children's learning development if they have learning difficulties.

The socialization process develops further, including the development of self-control, morality and friendships. Antisocial behaviour, including dishonesty and aggressiveness, begins and is easier to form at this stage than later, in adolescence.

Apparent abilities displayed by children at an early age may suggest that they are exercising parts of the brain intended for basic processing and developing instinctive linkages rather than reasoned linkages. Forced linkages of this type may make reasoned behaviour later in life harder as the instinctive linkages may operate faster than the reasoning functions of the brain.

Information received by the children beyond their experience will be interpreted within the framework of their experience, sometimes causing great anxiety and distress. Overexposure to themes such as war and sex may cause great difficulty later on as children have to reinterpret knowledge. If a child has unsupervised internet access, there is a risk of them being exposed to themes they are not developmentally ready for.

4.2.4 11-13 years

Children at this stage have entered a highly emotional space. They are just beginning to cope with hormonal changes brought about by the onset of puberty. They are also hitting a time when peers will have the most influence on them. They want to be poised and have self-control, but they are often clumsy and in conflict.

At this stage, children will exhibit many of these characteristics:

- Beginning to develop personal values.
- Learning to make appropriate decisions to resolve conflicts arising from the influence of peers.
- Defining themselves through environment, friends, clothes, culture, TV, etc.

- Developing the understanding that there are consequences to their actions.
- Learning to analyse risk factors.
- Showing empathy.
- Learning to handle emotions such as fear, frustration and rejection.
- Learning to express individual ideas in appropriate ways.
- Participating in a lengthy project that has a visible outcome (such as experimenting with fashion, trying out new activities, etc.).
- Beginning to accept personal and community responsibility.
- Developing leadership skills.
- Developing persistence.
- Exploring and examining rules to make sure the rules are fair.
- Identifying themselves with a peer group; they may do things with others that they would never attempt alone.
- Learning to accept and value other points of view.
- Communicating with peers through a variety of methods.
- Demonstrating the ability to set personal goals.

This is a period of life when some kids start dabbling in riskier behaviour (self-harm, smoking, drug use, sex, etc.). This can be exacerbated by access to certain types of internet platforms and services which can include social media, photo/video sharing platforms and instant messaging services.

4.2.5 13-18 years

The teenage years bring many changes, not only physically, but also mentally and socially. During these years, adolescents increase their ability to think abstractly and eventually make plans and set long-term goals. Each child may progress at a different pace and may have a different view of the world. In general, the following are some of the abilities that may be evident in a child's adolescence:

- Thinks more abstractly.
- Concerned with philosophy, politics and social issues.
- Thinks long-term.
- Sets goals.
- Compares oneself to their peers.

As during the period of adolescence children/teenagers begin to seek independence and control, many changes may occur. The following are some themes that may arise during the adolescent stage:

- Developing independence from parents.
- Peer influence and acceptance become important.
- Romantic or sexual relationships become important.
- May show long-term commitment in a relationship.

Teenagers essentially communicate as adults, with increasing maturity throughout their secondary education. As teenagers seek independence from family and establish their own identity, they begin thinking abstractly and become concerned with moral issues. All of this shapes the way they think and communicate. During this time, they will begin to interact and consume social media along with online content which may influence their development of their identity.

5 Children's use of Information and Communication Technology (ICT)

5.0 Introduction

In the following clause, the parameters of the use of technology that have implications for use by children will be systematically examined. In addition to developing a conceptual framework for future research, some specific issues of current interest will be emphasized. This is not a comprehensive list of issues, but, rather, selected concerns brought to our attention by stakeholders and frequently referred to in professional literature as well as by popular media.

5.1 Developmental mapping

The following three dimensions reflect individual traits and skills that develop as a result of genetically determined maturation and interaction with the environment. Each of these three dimensions is a composite of several developmental themes (some of them listed below), specifically selected in this context because they contribute to our understanding of the nature and prerequisites of ICT use by children.

Social development:

- from dependence to autonomy;
- from family to peer group as primary reference; and
- balancing individual needs and social commitments.

Cognitive development:

- development of communication skills;
- discrimination between reality and fantasy;
- ability to take the viewpoint of others;
- refinement of classification skills (from single to multiple features);
- logical thinking and abstraction, understanding causal relationships; and
- moral reasoning.

Physical maturation:

- development of sensory capabilities (vision, hearing, touch);
- skeletal strength;
- muscle strength;
- coordination, manual dexterity; and
- stamina.

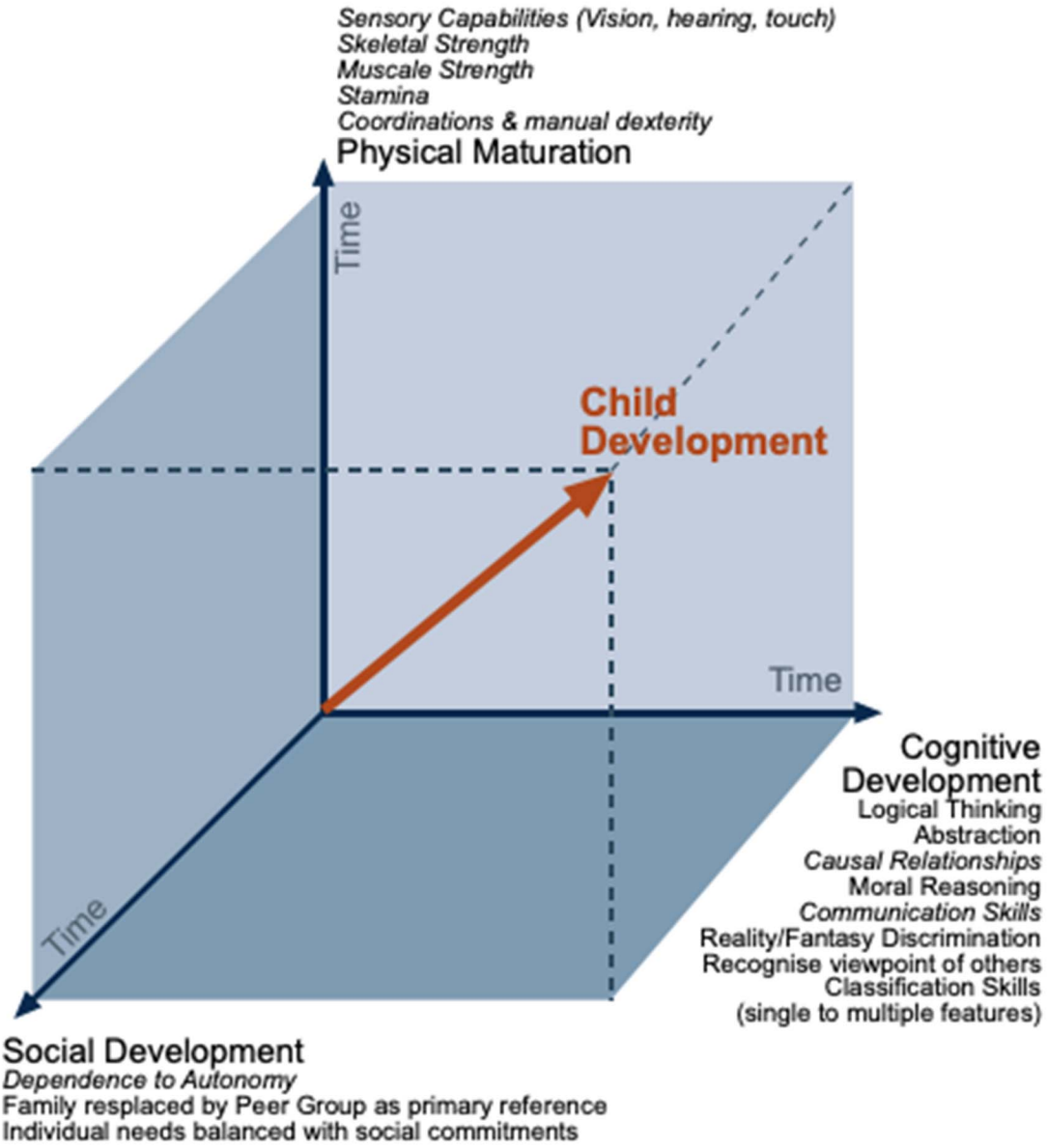

Figure 1: 3D conceptualisation of the three main development dimensions

The three developmental dimensions may be conceptualized as a three-dimensional space with time as the main parameter along all three axes (see Figure 1). At any given point in time, any individual may be characterized by his/her/their development along the three composite dimensions, perhaps utilizing a standardized set of test instruments. This will generate a single point within the 3D space for a single individual at a given point in time. This point need not coincide with the "standard" developmental trajectory (the vector labelled "Child Development"). A child could, for example, have a "normal" (statistically) cognitive development profile, and lack some social skills assumed to be normal for its chronological age as a result of a physical impairment that will also result in a lower physical development rating.

Taking all three dimensions into consideration, every child will be characterized by a single point in the 3D developmental space. The next step is to move from the level of the individual to the group - the Target Group referred to in Table 1. Collecting data on selected groups of individuals (e.g. seven-year-olds or visually impaired five-year-olds) will result in a cluster or scatter of points. Descriptive statistics may then be used to identify the central features of this cluster. The defining features of the "seven-year-old-cluster", for example, will be the point of departure for analyses using the "Aspects of Technology" matrix illustrated in Table 1. Individual variation in development is thereby considered, but since designers require general principles, the defining developmental features of specific target groups need to be identified. Designers can maximize the probability of a good fit between product/service on the one hand and user needs/capabilities on the other by generalizing findings for a specific target group.

Given this general structure, the different developmental parameters can be explored within a given context or situation of use. For example, the issues associated with the use of ICT in emergencies can be illustrated in the following way. A very young child or baby may not be aware that they are in an emergency and may not have the communication skills to express their concerns should they realize the danger. They are dependent on others recognizing that they are in danger and rescuing them. At such a young age they do not have the necessary physical maturity to escape from danger. This situation is illustrated in Figure 2.

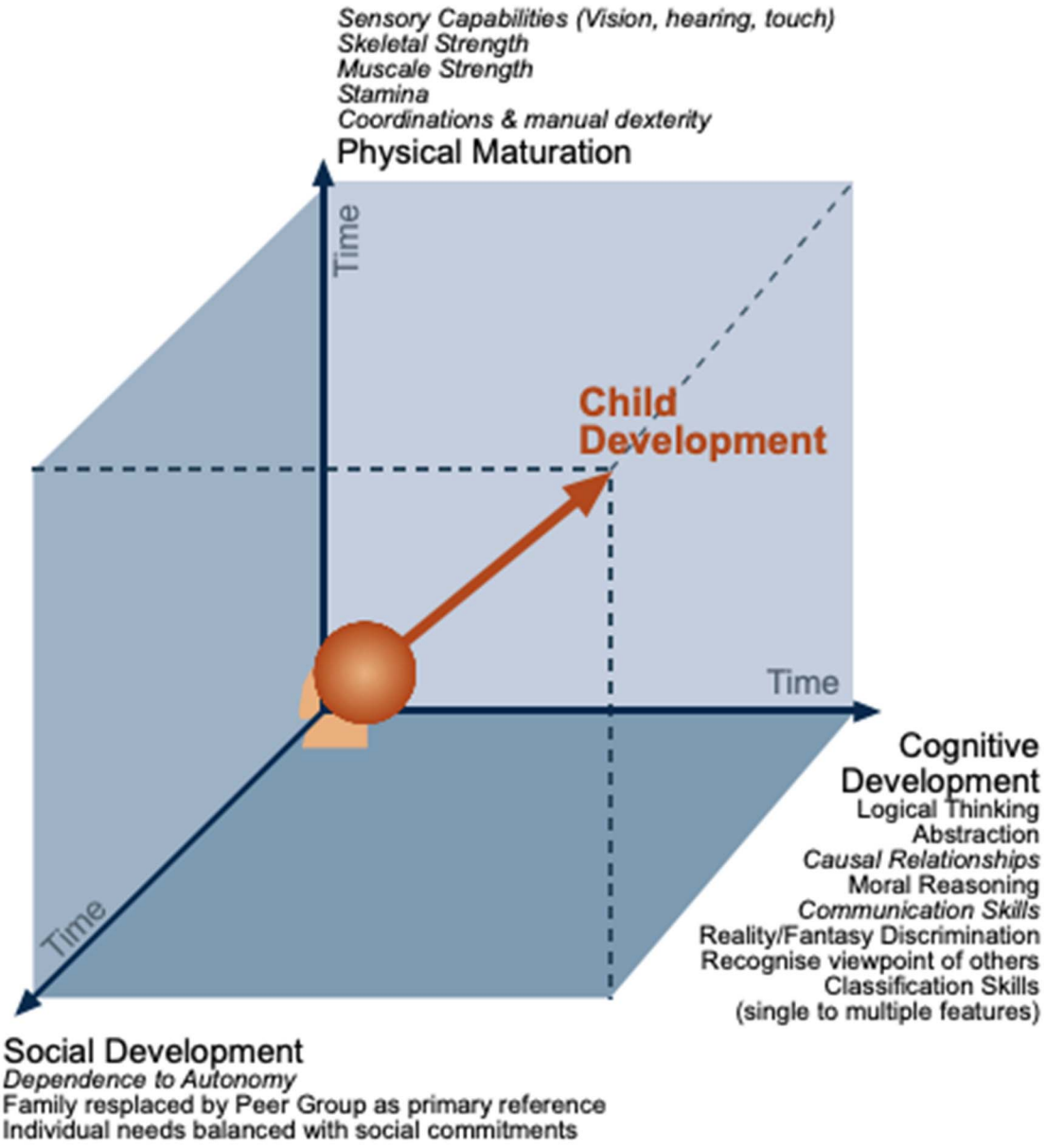

Figure 2: Developmental mapping of a cluster of young children

The role of ICT in this situation could be in the location of the child in order to rescue them from danger, or in the automatic detection of certain dangerous symptoms such as heat, sound or motion. Once the child is mobile and has some initial communication skills, they may be more able to escape from danger. They may still be heavily dependent on others, however, to alert them to the situation and to direct them to escape. This is illustrated in Figure 3.

In this case, the child could be provided with a communication and location device through which they could be instructed to move away from danger. This type of system raises issues of confidentiality and verification of who has the right to give these instructions and how the child can verify them before safely obeying them. The volume enclosed by areas on the axis does not represent the size of the market of children covered by a specific context of use, but rather it represents the proportion of children from within the whole market of children.

Having located a developmental "stage" within this three-dimensional space, i.e. having fully described a target group in terms of its social, cognitive and physical characteristics, one moves on to a systematic description of the child's interaction with technology. As children use technology, they will interact with different aspects of the overall system. By considering these different aspects in turn, the implications for the use by children can be systematically explored, and the relevant issues exposed.

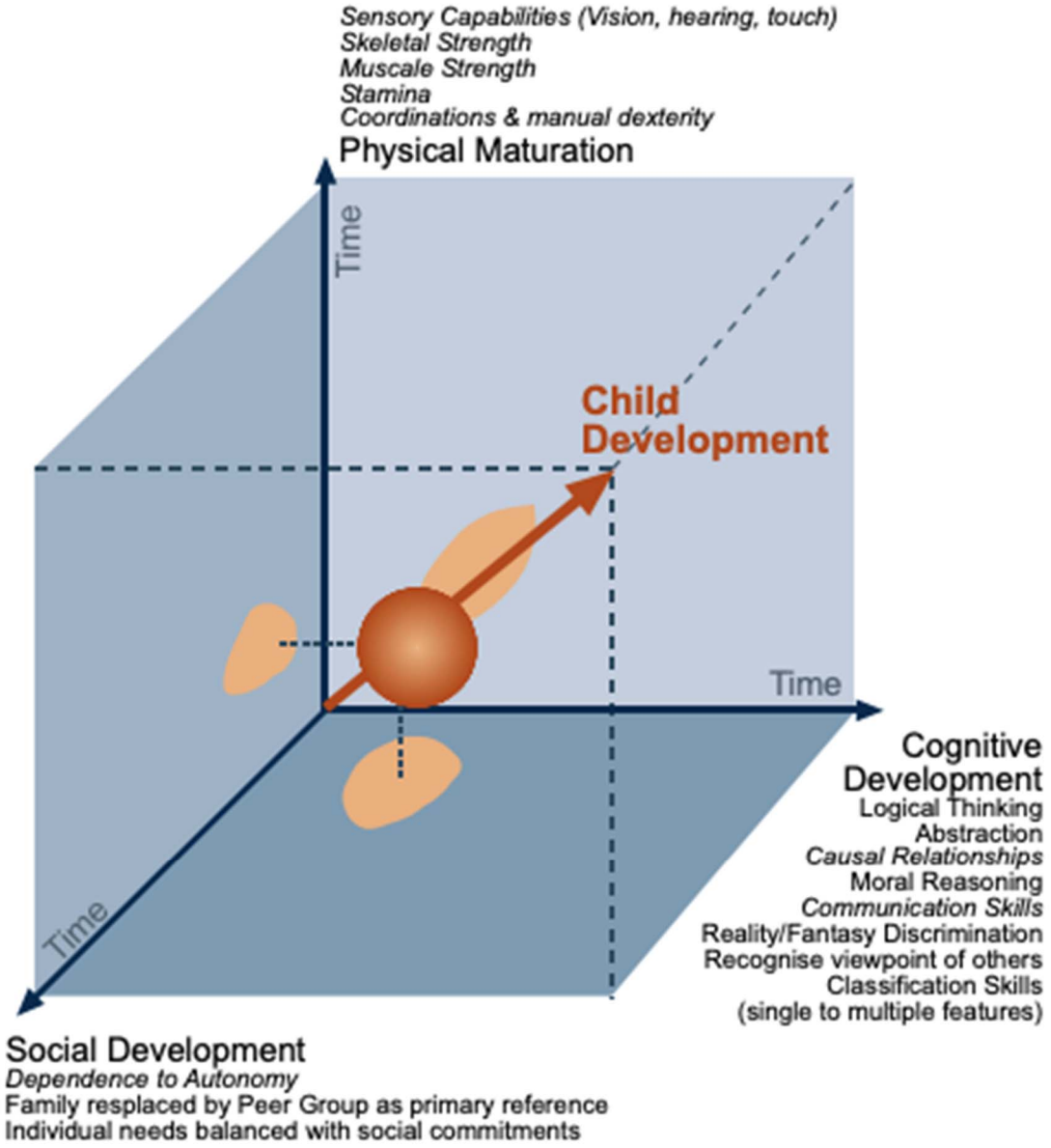

Figure 3: Developmental mapping of a cluster of older children

The various interactions involved in the use of ICT can be represented within a structured framework. This allows each aspect to be exposed and explored systematically. This framework is represented in Table 1. As a child develops, the nature of the interactions with an ICT system and the issues arising from their interaction change. The developmental profile generated by the approach described above will, for any given target group, bring to light qualities typically associated with that group that need to be taken into consideration by designers. The developmental profile may also suggest areas where products and services are lacking. Target groups may be selected based on chronological age, and educational level as well as by other defining characteristics such as specific physical and cognitive impairments. See clause 5.7 for an illustration of how this analytical approach can be applied to a specific target group.

Table 1: Matrix describing relevant issues related to five aspects/parameters of technology for selected target groups

	Aspects (parameters) of technology				
	Location and Context	**Physical Characteristics**	**Operating Characteristics**	**Services**	**Content**
Target Group 1	Issue "a" Issue "b"		Issue "c"		
Target Group 2		Issue "d"			
Target Group 3			Issue "e" Issue "f"		Issue "g"
Target Group n		Issue "h" Issue "i"			

Further elaboration and empirical investigation are required to uncover how the three developmental dimensions interact and contribute to the observed development of ICT proficiency and use by children. This present document is of the opinion that this is an essential first step, however, in the process of identifying issues and formulating guidelines and checklists for ICT designers.

Each of the five aspects or parameters of technology will be elaborated below and key issues related to ICT use by children identified. Some of these issues have been investigated and cited by experts as examples of issues that need to be resolved, while others have at the present stage been insufficiently explored.

5.2 Location / Context

Children use technology in many different locations and for many different activities. This raises a wide variety of issues specific to the fact that children are the users. This clause will consider where the child will be using the technology, including the context of use.

Examples of location and contexts that highlight these child-specific issues include:

- unsupervised use of a mobile phone (typically a smartphone) in a public place;
- supervised use of an educational technology system in a school;
- restricted surfing of the Internet at home; and
- games playing on a portable device (typically a smartphone) whilst travelling to school.

Issues that arise from use in these situations include:

- safety of use in a given context. Examples include, a child answering a mobile phone whilst riding a bicycle, or attempting to make an emergency phone call during a power cut;
- the right to use the system in a given context, including the payment for the use;
- the rules of appropriate use, including aspects such as the child being aware of them and the child acknowledging the authority of the person or body prescribing the acceptable use and consequently conforming to them. If the child does not obey the acceptable use policy, an issue is raised concerning the responsibility for enforcing this policy and for determining which party to sanction;
- in order to ensure that the use of the ICT system is appropriate the provider of the system or service may consider the need to ask for details about the user and the location and context of use. This may raise issues of confidentially of information and its secure storage and use; and
- depending on the location and context of use, it may be inappropriate for the child to be interrupted by additional unsolicited information being presented to them.

5.3 Physical Characteristics

Children do not have the same characteristics as adults. Their skeletal and nervous systems are not mature; they do not have the strength or stamina that an adult would be expected to have. As they are maturing physically, they are vulnerable to damage from excessive use of or exposure to equipment that is not designed for their developmental level. This raises numerous issues about the physical characteristics of the equipment and its suitability for the child's purposes. Notably, media have recently called attention to microwave radiation exposure from mobile handsets and repetitive strain injury in children who are heavy users of instant messaging or gaming input devices, appropriately termed texting thumb (a repetitive injury that develops from constantly holding, scrolling, and texting on a smartphone or tablet).

The potential dangers to children of exposure to high levels of radio frequency microwaves emitted by mobile telephones have generated public debate. While no conclusive evidence of adverse effects of radiation exists, concern among parents and health officials is increasing as mobile phone penetration increases. By age 11, 91 % of children in the UK own a smartphone, according to data from the country's communications regulator, Ofcom, while a study of 19 European countries found 80 % of children aged nine to 16 used one to go online daily, or almost daily. Meanwhile, recent survey data suggests that 42 % of US children have a smartphone by the age of 10, with 91 % owning one by 14 [i.26]. And it is not just that smartphones have become more prolific: the average length of time children and young people - and adults - spend on their devices has been ticking up in recent years. The trends have been supercharged by lockdowns: 79 % of UK parents reported their children's screen time was up post-pandemic, though the latest 2023 global figures appear to show a return to pre-pandemic levels for adults. According to data from the Centers for Disease Control and Prevention in 2018, the average 11-to-14-year-old in the US spent nine hours daily in front of a screen. Taking a proactive stance, the Bangladesh government has decided that mobile phones could potentially be harmful. Bangladesh plans to ban mobile phones for children under 16 to protect them from what it says is exposure to radiation that could damage their brains. In May 2000, a special committee in the U.K., the Independent Expert Group on Mobile Phones (also known as the Stewart Commission) issued a report [i.11] on mobile phone safety issues. With reference to children, the Stewart Commission concludes: "...the widespread use of mobile phones by children for non-essential calls should be discouraged and... the mobile phone industry should refrain from promoting the use of mobile phones by children." ([i.11], section 1.53).

The U.S. Department of Health and Human Services, Food and Drug Administration summarize research findings and make the following recommendation on their official website [i.12]:

- *The scientific evidence does not show a danger to users of wireless phones, including children and teenagers. If you want to take steps to lower exposure to radio frequency energy (RF), the measures described above (see note) would apply to children and teenagers using wireless phones. Reducing the time of wireless phone use and increasing the distance between the user and the RF source will reduce RF exposure.*

In addition to these general aspects, more detailed points may include:

- ergonomics of the relationship between system unit, input devices and output display;
- ergonomics of the input devices relative to the strength and co-ordination skills of the child;
- weight and portability of the device;
- brightness and legibility of the display;
- the operating behaviour related to the safety tolerances of children as opposed to those acceptable for adults;
- the physical design of the system, and whether it is suitable for the environment that it is likely to be used in.

For example, a device may be left outside in the rain:

- the degree to which the design is styled to reflect its use by children, and the degree to which this styling is suitable for children. This includes attributes such as being customizable;
- the portability of the devices, including the facility for it to be considered as wearable;
- the power supply, including batteries and feedback about their status being in a form that can be comprehended by a child; and
- the use of text and other representational metaphors to assist the child in operating the system, particularly as abstract metaphors may not be comprehensible to a child.

5.4 Operating Characteristics

Not only should a child be able to physically operate an appropriate ICT system, but they should also be able to negotiate the basic operation of the system at the software level. Various parameters may influence the successful comprehension of the operation of the system, and the ability to execute the procedures necessary to operate and configure the system, to ensure that it is ready to do the required tasks. Gilutz and Nielsen [i.9] point out that children's difficulties in using Websites are caused by factors such as lack of navigational confirmation of the user's location, inconsistent navigating options and non-standard interaction techniques. This might be thought of as the software issues related to the "enabling tasks" of getting the system to a state where it is ready to be used for the intended task. The issues involved may include, for example:

- navigation through options;
- invoking and closing communications or information exchange processes;
- comprehending instructions;
- general media storage and retrieval;
- identification as the legitimate user of the system and security validation at a level that is appropriate for children;
- configuration, representation and operation of short-cuts; and
- configuration and operation of restrictions on facilities appropriate to children, including access by children to configurable aspects of the system.

Usability findings for adults cannot necessarily be generalized to children. To illustrate this extremely important point Gilutz and Nielsen [i.9] list some of the more striking differences:

- Animation and sound effects were positive design elements for kids, while often a nuisance or obstacle for adult users.
- Children display a greater willingness to "mine-sweep" in order to find clickable elements on web pages.
- Geographic navigation metaphors (pictures of rooms or 3-D maps) work for children.
- Children rarely scroll pages and interact mainly with visible information without scrolling up or down.
- Surprisingly, half of the children in the Gilutz and Nielsen study were willing to read instructions, commonly a last resort for adult users.

5.5 Services

Having ensured that the basic system is usable, it will be necessary to consider issues arising from the use of the system to access communication and information exchange services. A wide variety of issues may be involved, including:

- opening and closing communication channels with the correct and appropriate communication partners;
- the possibility of being contacted by legitimate and inappropriate communicating parties;
- determining who the communication partners are;
- bringing communicating parties into a multiparty session;
- navigating through information stores;
- capturing information or communicated media; and
- configuring the operating characteristics of the service, and comprehending the process, the instructions and the representation of the options and the state of the service.

5.6 Content

5.6.0 Introduction

The following clause will focus on content on the Internet and mobile services. In order to identify issues requiring action, these areas will be considered jointly, as a convergence of technologies and the increasing prevalence of hybrid services have rapidly made the distinction between Internet and mobile telephony less relevant. Issues that are unique to either domain will, however, be pointed out.

The child is born into and develops within a sociocultural setting. The child's first encounters with telephony and the Internet are usually regulated and mediated by prevailing attitudes that reflect what society considers comprehensible, appropriate and "normal". Threats - imagined and documented - to the child's physical and emotional well-being have resulted in a wide range of guidelines as well as legislative action to protect children in the face of such dangers, in addition to impassioned public debate. The purported benefits of ICT use, both substantiated and unsubstantiated, in specific areas such as education, have given rise to an industry focused on it. As mobile phones and the Internet found their way into primary schools and the public arena in general, it becomes increasingly important to secure access for all children - cultural/linguistic minority groups as well as groups with non-standard user interface requirements and children needing modifications in the way services are offered. The following clause examines the impacts and implications of such cultural variables on ICT use by children as they relate to the comprehension and control of content.

5.6.1 Comprehension

Comprehension is a process that involves not only decoding messages, but also making additional inferences about meaning and, at more advanced levels, the explicit and covert intentions of the message source.

Young children, e.g. pre-schoolers, are beginner readers who can encounter difficulties in mastering media literacy events such as understanding bedtime stories, labels and signs, interpreting instructions for games and toys, and understanding messages and situations. They also have limited ability for abstract thinking. Gilutz and Nielsen [i.9] in their study of how 55 children (grades one to five) used the Web, found that young children and beginning readers had problems dealing with large amounts of text. Problems arose when they navigated into sections of text that were written at a different level than their current reading skills could cope with. The researchers also found that fancy wording rather than straightforward language easily confuse young readers, preventing them from understanding the options available to them. To this, an option could add that ethnic migration also exposes children of all ages to cultures and languages different than their native ones, with subsequent comprehension difficulties. Indigenous minority language communities exist in many parts of Europe as well. Although older children and adults are generally capable of speaking and understanding the majority language that surrounds their communities, younger children often lack the language skills needed to interact with their more inclusive environment.

Furthermore, children's ability to comprehend persuasive intent on the part of content providers is related to age. In television children typically begin to distinguish between advertisements and programmes and understand that the purpose of commercials is to persuade them to buy around the age of 7 or 8 [i.2] and [i.3]. On the Internet, it seems that even children of 9 to 11 years may not be aware of the commercial intentions of many websites.

It has been noted that comprehension of the privacy concept differs from children to adults: 10- to 17-year-olds are much more likely than their parents to give sensitive personal and family information to commercial websites in exchange for rewards of various sorts [i.4].

The blurring of boundaries between reality and fiction, between the actual and the virtual, may be an important issue for young children interacting with toys in the future. For example, there are dolls and action figures that can be shaped by downloading different "personalities" from the Internet. Children and their toys can also enter online virtual communities by means of large screens or head-mounted displays while being tracked by global geo-positioning systems. Physical toys can communicate with each other, with the user, with the Internet and, more significantly, with the manufacturer. There is still much-needed research focus not only on social and cognitive developmental implications associated with interacting with deceptively life-like virtual friends but also a regulatory focus on marketing and data collection when manufacturers can use toys to infiltrate the home.

5.6.2 Legal and ethical concerns

The characteristic Internet use patterns of children are difficult to measure. Entertainment is the primary attraction for children, but attempting to describe and document activity is like trying to hit a moving target [i.9]. Children mature, preferences change, technology advances and new knowledge bases emerge and spread among this networked generation. Access to the Internet varies widely depending on the country's income group, the rural-urban divide as well as household wealth [i.26]. Globally, only 33 % of children and young people (0-25 years old) have internet access at home. However, there is a significant gap between high-income and low-income countries, with 87 % coverage compared to 6 %, respectively. Strong inequality in digital connectivity can also be seen across the world's regions. In Eastern Europe and Central Asia, approximately 60 % of children and young people aged 25 years or less have internet access at home. A similar situation is observed in the East Asia and Pacific and Latin America and Caribbean regions, where at least 50 % of children and young people have internet. Household wealth is an important factor, with the lack of internet access most acute for the poorest children and young people in low- and lower-middle-income countries. The biggest gaps between the poorest and richest households, however, are observed in the upper-middle-income countries. In those countries, 82 % of children and young people from the wealthiest households have internet access at home, while only 28 % of their counterparts from the poorest households do. This pattern is also seen in high-income countries, where 97 % of children and young people from wealthy households have internet access at home, compared to only 74 % of their poorest peers.

The social and economic aspects of mobile phone use are two sets of concerns that have been voiced by parents and educators. Mobile or Smartphone use in classrooms is disruptive, and a variety of measures are being employed to prevent undesirable consequences of use in schools. In addition to potential safety hazards, parents are expressing a variety of other concerns: increased susceptibility to theft and physical harm in connection with robbery, footing the bill for what may be hours of use, the initial cost of the terminal and peer pressure (reinforced by targeted marketing campaigns) to upgrade to the latest model, harassment and unsolicited calls and messages.

What concerns most parents with regard to these media is the content (64 % rather than the amount of time spent with the medium (21 %). With TV, four problematic content themes have been identified, namely violence, sex, crude language and adult dialogue. The interactive nature of the Internet widens the area of concern about content and extends beyond it.

Value-sensitive design attempts to connect the people who design systems and interfaces with the people who think about and understand the values of the stakeholders who are affected by the systems. This approach to the design of ICT artefacts centres on human well-being, human dignity, justice, welfare, and human rights and serves as a tacit foundation for much of the public debate this present document encountered. With reference to children and ICT use, this debate has focused on the following four sets of issues:

- exposure to inappropriate material;
- internet and direct messaging through mobile/smartphone harassment of minors;
- legal and financial concerns (e.g. piracy, hacking, financial accountability, marketing, etc.). As children have access to ICT earlier and earlier in their lives, experts in piracy, hacking and other forms of Internet mischief emphasize that any effort to tackle the illicit trade in digital goods (video games, software, music and movies) should be targeting younger children as a preventative measure. Since norms of conduct are established within peer groups, critical periods and contexts for norm formation should be identified and targeted for prevention. In addition, marketers are beginning to recognize the marketing potential of the Internet, and, more recently, the mobile/ smartphone;
- grooming, and sexploitation lead to physical molestation. Reports of physical molestation of minors following initial contact made using direct messaging apps and/or service exchanges are becoming disturbingly common. Preventative measures are required.

Attempts on the part of government authorities, service providers and special interest groups to influence content delivery and utilization by means of the Internet to homes and schools may be divided into four basic approaches:

- education and awareness;
- rules and guidelines;
- regulations; and
- legislation.

The US and Europe have taken different approaches to content regulation.

In the USA, CIPA (Children's Internet Protection Act of 2000) was enacted by Congress in 2000 to address concerns about children's access to obscene or harmful content over the Internet. CIPA imposes certain requirements on schools or libraries that receive discounts for Internet access or internal connections through the E-rate program - a program that makes certain communications services and products more affordable for eligible schools and libraries. In early 2001, the FCC issued rules implementing CIPA and provided updates to those rules in 2011 [i.27].

In the UK, the Online Safety Act 2023 (the Act) is a set of laws that protects children and adults online. It puts a range of duties on social media companies and search services, making them more responsible for their users' safety on their platforms. The Act gives providers duties to implement systems and processes to reduce risks their services are used for illegal activity, and to take down illegal content when it does appear. The strongest protections in the Act have been designed for children. Platforms will be required to prevent children from accessing harmful and age-inappropriate content and provide parents and children with clear and accessible ways to report problems online when they do arise. The Act also protect adult users, ensuring that major platforms will need to be more transparent about which kinds of potentially harmful content they allow, and give people more control over the types of content they want to see [i.28].

In the EU, the Digital Services Act (DSA) regulates online intermediaries and platforms such as marketplaces, social networks, content-sharing platforms, app stores, and online travel and accommodation platforms. Its main goal is to prevent illegal and harmful activities online and the spread of disinformation. It ensures user safety, protects fundamental rights, and creates a fair and open online platform environment [i.29].

5.6.3 Marketing and Privacy

Children have growing personal spending power and influence over their parents' purchasing decisions [i.6]. It has been known for a while of the effectiveness of online marketing to children. Therefore, it is not surprising that from 1993 to 1996 advertising in child-oriented media increased more than 50 % and that in 1996 the market sales of licensed products for infants increased 32 %. This influence is not limited to children's products but encompasses everything in the household.

A European working group on commercial practices aimed at children set up by the Consumers Committee at its meeting of 6 December 1999 has recently concluded that children are particularly vulnerable to commercial pressures on the Internet. It is an appealing and personally engaging medium, which experts claim, puts children into a "flow state", making them very receptive to advertising. It allows for more sophisticated ways of marketing, which are interactive and one-to-one targeted. Websites specifically dedicated to children, with the aim to sell directly to children, are already very common on the Internet.

The principle of spatial separation of advertising from the decision to purchase should be adhered to when communicating with children by means of the Internet. Because they are more impulsive and less concerned about the consequences of their actions, an advertisement accompanied by a box to click, and buy is a special temptation for children. Logos and signals (popular melodies) are also being marketed directly to children via SMS, and payment is collected for providers of these services by network operators.

On the Internet advertising and content are commonly merged, and it is even more difficult for children to make a distinction between advertising and content in this new media. For example, children's websites enable young people to interact with the main character, learn what products he purchases and click on advertisers' sites or online purchasing forms. Online game sites, increasingly popular with children, incorporate logos and develop game scenarios closely linked to products targeting young consumers.

Integrating advertising and website content enables companies to create brand loyalty at an early age when children are anxious to belong and be accepted by their peer groups. For example, banner ads appear at the top of many websites, even children's websites, and hot links to the sponsor's site. Many children's websites have been pressured to put the word "advertisement" next to the hotlink as well as to insert bridge pages, clearly a step in the right direction. One of the most notable findings in the Gilutz and Nielsen study [i.9] was that children tend to click on advertisements on websites - often by mistake, however, thinking they are just one more element of the site. Tagging advertisements with PAID or AD markers had little or no effect. Very few adults have been observed clicking on advertisements, and many are rapidly developing a form of immunity, blocking out commercial content.

Some sites seem to promote smoking and also teen-friendly alcohol advertising sites. In a survey by EKATO, the Greek consumer organization, all the children who participated in the study, admitted visiting either pornographic or gambling sites.

Parental consent for sales transactions should be enabled. Mechanisms are beginning to be provided for children's online accounts, but the norm is for children to make purchases using their parents' credit cards. There is no systematic check on the age of purchasers on the Internet despite the fact that the anonymity of the net obscures this. This makes it too easy for children to "borrow" their parent's card and cause family friction. Prepaid mobile phone cards guaranteeing anonymity also make it impossible to verify the age of the end user.

Commercial websites have developed a number of strategies for developing personalized one-to-one relationships with children to learn more about them in order to market their products in a better way. For example, many commercial sites entice children to supply their names, addresses and names of their friends by making it necessary in order for them to participate in various activities on the site. Children's and family's right to privacy can be invaded by using profiling tactics [i.6] that consist of either tracking online browsing behaviour ("clickstreams") by using "cookies", or asking children directly to provide detailed personal data, such as name, age, gender, e-mail and street address, telephone number, favourite TV shows, interest in music groups, purchasing preferences, parents' credit card number, information about family social status and members. This disclosure of personal data, usually sought without parents' permission, can be encouraged through gifts (T-shirts, mouse pads, screen savers, club memberships, opportunity to role-play in a game) or online prizes (Sign-up and win points), or can be presented as mandatory (filling a registration form or answering a questionnaire as a condition to play a higher level game or enter a context), or disguised as a loyalty test. The information about online visitors, their habits and interests are then used through Customer Relationship Management techniques to establish individual relationships (one-to-one marketing), craft personalized ad messages (micro-targeting), and develop long-lasting brand loyalty.

The General Data Protection Regulation (GDPR) is a legal framework that sets guidelines for the collection and processing of personal information from individuals who live in and outside of the European Union (EU). Approved in 2016 and put into effect in 2018 [i.30]. It aims to give consumers control over their own personal data by holding companies responsible for the way they handle and treat this information. The regulation applies regardless of where websites are based, which means it will be heeded by all sites that attract European visitors, even if they do not specifically market goods or services to EU residents. It replaced an earlier law, the Data Protection Directive, and was set up to regulate the way companies process and use the personal data they collect from consumers online. It also has rules in the way that information is moved, whether that's partly or entirely through automated means. The law makes it difficult for companies to mislead consumers with confusing or vague language when they visit their websites. It also ensures:

- Website visitors are notified of the data collected.
- Visitors explicitly consent to that information-gathering by clicking on a button or some other action.
- Sites notify visitors in a timely way if any of their personal data held by the site is ever breached.
- There is a mandated assessment of the site's data security.
- Whether a dedicated Data Protection Officer (DPO) needs to be hired, or an existing staffer can carry out this function.

Within GDPR there are consent requirements for children, in the context of providing information society services, because "they may be less aware of the risks, consequences and safeguards concerned and their rights in relation to the processing of personal data". Therefore, under EU law, when providers of information society services process the personal data of children under the age of 16 years on the basis of consent, such processing will be lawful "only if, and to the extent that, consent is given or authorised by the holder of parental responsibility over the child". Member States may provide for a lower age in national law, though not lower than 13 years. Consent by the holder of parental responsibility is not necessary "in the context of preventive or counselling services offered directly to a child."

Information and communication where processing is addressed to a child should be in clear and plain language easily understandable by the child.

The EU/EC have a strategy to create a Better Internet for Kids (BIK+) adopted on 11th May 2022 to ensure that children are protected, respected and empowered online [i.31]. This has three actions to it:

1) safe digital experiences to protect children from harmful and illegal online content, conduct, contact and risks as young consumers and to improve their well-being online through a safe, age-appropriate digital environment, created in a way that respects children's best interests;

2) digital empowerment so all children, also those in situations of vulnerability, acquire the necessary skills and competencies to make sound choices and express themselves in the online environment safely and responsibly;

3) active participation, respecting children by giving them a say in the digital environment, with more child-led activities to foster innovative and creative safe digital experiences.

Among the ongoing initiatives to deliver concrete solutions for a better and healthy use of the internet for children and young people, BIK+ are working towards standard age assurance and verification methods in Europe, support for rapid assessment of illegal and harmful content, and ensuring the '116 111' number offers help to victims of cyberbullying, are just a few of the steps being taken.

An example of legislation designed to protect the rights of children with respect to data collection is COPPA (Children's Online Privacy Protection Act of 1998 (US)). This act makes it unlawful for an operator of a website or online service directed to children, or any operator that has actual knowledge that it is collecting personal information from a child, to collect personal information from a child in a manner that violates specific regulations specified in this law. It also gives parents control over what information websites can collect from their kids. The COPPA Rule imposes certain requirements on operators of websites or online services directed to children under 13 years of age, and on operators of other websites or online services that have actual knowledge that they are collecting personal information online from a child under 13 years of age. This is currently in the process of being updated.

5.6.4 Approaches to controlling content

Content control may be divided into different basic categories:

- blocklists;
- category filters;
- keyword filters;
- monitoring use; and
- separate "kids" domains.

The Internet Content Rating Association (ICRA) is an international, independent organization that empowers the public, especially parents, to make informed decisions about electronic media employing the open and objective labelling of content. ICRA's dual aims are to:

1) protect children from potentially harmful material; and

2) to protect free speech on the Internet.

There are two elements to the system:

- The content provider fills in an online questionnaire describing the content of their site, in terms of what is and is not present. ICRA then generates a Content Label (a short piece of computer code) that the content provider adds to his/her site.
- Users, especially parents of young children, can then set their Internet browser to allow or disallow access to websites based on the objective information declared in the label and the subjective preferences of the user. The ICRA system can be used with most internet browsers immediately, with wider applications under development.

A key point is that the Internet Content Rating Association does not rate Internet content - the content providers do that, using the ICRA system. ICRA makes no value judgement about sites. ICRA's labelling system is designed to be as objective as possible and to cover a wide range of content types. The system gives users a great deal of flexibility in their choices of what should and should not be seen in their homes or workplaces. The browser's filtering system can of course be disabled and enabled easily if the users have access to the password.

The broad topics covered are:

- The presence or absence of nudity.
- The presence or absence of sexual content.
- The depiction of violence.
- The language used.
- The presence or absence of user-generated content and whether this ismoderated.
- The depiction of other potentially harmful content such as gambling, drugs and alcohol.

Within each category, the web author is asked questions about whether a specific item or feature is present or absent on the site.

The ICRA questionnaire can be completed in several different languages; however, the labels themselves are expressed as computer code. The ICRA labelling system is therefore independent of any given (human) language. Descriptors from other vocabularies may be used in conjunction with ICRA labels and the organization is willing to consider extensions to its vocabulary where circumstances demand it.

This website is offered in a variety of languages too, however, ICRA's working language is English. The English version of the website is therefore typically more up to date than other language versions.

ICRA labels are expressed using the Resource Description Framework (RDF) as defined by the World Wide Web Consortium. Specifically, ICRA was instrumental in defining and now uses RDF Content Labels, a generic platform designed to support digital labels and trust marks of all kinds. The use of RDF means that ICRA labels are part of a much bigger global effort to make sense of the mass of online data known as the "Semantic Web." RSS news feeds, blogs, shared bookmarks and many other technologies are based on RDF and related standards.

While the Internet's fluidity and the abundance of content have made it a rich trove of information, long-held concerns about credibility, malicious content and cyber-bullying, remain [i.32]. As fake news, click-bait and hate speech grow in prevalence online, governments are working to find ways to protect families from content deemed too sexually explicit, violent, or dangerous. For its part, the UK government has pushed Internet Service Providers (ISPs) to enable web filtering of dangerous or malicious content online. Working with providers, the government announced that family-friendly network-level filtering would be available to all new and existing broadband customers by 2014. Anyone subscribing to a broadband service now will find that the filters are automatically enabled. Similar measures are found in different countries around the world.

Web filtering or web blocking involves the restriction or control of content that Internet users are able to access via their ISP. The family-friendly network level filters brought in by many broadband providers mean that UK Internet subscribers are prohibited from accessing a range of websites by default, specifically adult or illegal content.

The filters are based both on lists of blacklisted or restricted websites and through an automatic scan of keywords to determine whether a site should be filtered. The majority of categories filtered are related to violence, obscenities, or nudity. However, ISPs also work to block websites that contain malware or attempt to "phish" sensitive information like usernames, passwords, or credit card details. Filtering consistency among ISPs is sparse, as each has its own way of categorizing and filtering content.

For most ISPs, web filtering occurs automatically. Internet subscribers wanting to access blocked content can choose to 'opt-out' of the network-level filters by logging into their ISP account controls. What's important to remember is that these filters exist at the network level, meaning that even with customization, all users within a household are subject to the same web filters. This is great for parents, who do not need to worry about what device kids are using to access the internet, but it can be restrictive for the adults and older children in the household. Instead of a full-on opt-out, other options do exist. Internet subscribers can customise their filters to their needs, avoiding feverish web-blocking, but maintaining some form of controls. ISPs provide features like timer, homework mode, category controls, or blacklisting and whitelisting, which allow subscribers to select time slots, categories, or selective websites they opt to filter the content of.

5.7 Applying the approach to a specific target group

It is beyond the scope of the present document to provide an exhaustive evaluation of every ICT service that children can be expected to encounter in their daily lives. Our intention has been, rather, to suggest an analytical framework within which such endeavours can be carried out at some future time. This clause illustrates how the analytical approach described above can be put to practical use. The chosen target group consists of children between the ages of twelve to fourteen using smartphones in a public place. Based on child development, children at these ages are transitioning to middle school, and this is the time many may feel entitled to own a smartphone and have access to educational websites for kids. At this age, most adolescents have developed vital skills, such as problem-solving, impulse control, and critical thinking [i.33]. Therefore, while most adolescents are ready for supervised smartphone use, some might still be lagging in terms of their level of maturity.

Table 2 provides an overview of a set of issues related to a single target group of users in a specific context. It also highlights the fact that much research is needed to explore the spectrum of issues in any given usage context.

Table 2: Matrix describing relevant issues related to smartphone use by children

	Aspects (parameters) of technology				
	Online Interactions	**Physical Characteristics**	**Operating Characteristics**	**Services**	**Content**
12-14 year old children	1) Issues Cyberbullying **Recommendation:** Keep records. Keep screen shots of the threatening messages, pictures, and texts. These can be used as evidence with the bully's parents, school, employer, or even the police. Block, utilise settings that let the user electronically block emails, messages, or texts from specific people.	1) Issue Eye strain from mobile phones Issue Decreased attention span **Recommendation:** Screen time limits, restrictions on what apps they can use or where they can use their phone.	1) Issue Cybersecurity, privacy and safety, **Recommendation:** Do not share passwords with friends or strangers. Keep the phone close in a bag or on-hand rather than leaving it in public places where it can be stolen. Password protect the phone so that if it is stolen, personal photos or messages cannot be easily accessed.	1) Issue Unprotected use of social networking. **Recommendation:** Do not overshare online.	1) Issue Access to unsuitable content The internet is home to many things, including inappropriate and adult content.. **Recommendation:** Utilise parental controls & engage with the child's phone usage

It should be emphasized that the approach proposed is primarily an analytical tool that "bounds" thinking and generates a set of issues based on in-depth knowledge of the child's physical, cognitive and social development. This approach is not proposed as a substitute for detailed observation and analysis of children interacting with technology in laboratory and naturalistic settings. Issues of concern to telecom service providers and ICT designers catering to the needs of children will ideally be identified by applying the type of methodology described in this clause in combination with detailed observational studies of technology in use.

6 Market characteristics

This clause provides information about the status of the market for ICT products and services for children.

The market for ICT products and services for children is very complex. The users - children - are not one homogeneous group (see clause 4). They have different needs depending on their age, sex, culture and developmental characteristics. These needs also rapidly change over time. Products for children generally are to be "thrown away", with a short life. There is a trend for products designed to be upgraded, refurbished, reused and/or recycled.

In human-computer interaction (HCI) research, the participation of users is considered a valuable and worthwhile activity. Children can be involved in design at all stages. In a traditional design lifecycle, the maximum benefit from interaction with children will be at the early stages (for ideation) and during iterations of design where feedback is crucial [i.34].

Historically, children did not actively contribute to the design of interactive technology targeting child users. The practice of involving children as co-designers is still a relatively new idea. Methods for engaging with children in design are primarily concerned with asking children for ideas for new interactive products. This generally takes the form of children engaging in one or more "design sessions" that are structured to generate design contributions towards an interactive product or system. The purpose of engaging with children in the design process is that they suit the children's needs and are not simply adult designs adapted for children.

An analysis of stakeholders has shown the following groups and individuals have an interest in the design of products and services specifically for children:

- Technical Bodies:
  - ETSI groups such as 3GPP/;
  - Other standards groups such as:
    - CEN ISSS;
    - CEN TC 224;
    - ITU-T;
    - ANEC;
  - Telephone companies;
  - Mobile phone companies; and
  - PC Manufacturers;
  - Toy/Games Manufacturers.
- User Groups:
  - Human Factors and Telecommunications community.
  - Academics.
  - Consumer groups.
  - Education groups.
  - National Ministries of Education.
  - Children's disabilities groups.
  - Children's charities.
  - Children's rights groups.
  - UNICEF, UN Human rights.

7 Legalisation and Regulation

7.1 Introduction

This clause focuses on EU legalisation with how they impact children. These are points companies and service providers need to consider when they have users and/or customers who are children. While this clause will not look at national legalisation it is something companies have to be aware of their obligations under them. These include for example the *UK's Online Safety Act* and *France Law no.2022-300 / Decree no.2022-1212* encourage the use of parental controls on certain equipment and services sold in France and allow access to the Internet.

7.2 Legislation

7.2.1 Digital Services Act (DSA)

The DSA will make sure that all digital services that are used by consumers, especially the so-called Very Large Online Platforms (VLOP) and Very Large Online Search Engines (VLOS) do more to protect users' rights, keep users safe and stop the spread of illegal or inappropriate content [i.35]. The DSA covers different types and sizes of online services, used by anyone in the European Union, wherever the service is based. It sets stricter rules for the biggest services. The DSA requires online platforms to consider the impact of their services on important issues such as fair elections, public safety, the mental and physical well-being of users, and gender-based violence.

Within the DSA Article 28 says that online platforms that can be used by minors need to make sure their services offer a high level of privacy, safety and security to young users. Examples of what measures VLOPs and VLOS will follow include.

For online risks for minors VLOPs and VLOSs will consider: - if minors will easily understand how the service works:

- if minors risk finding content that could harm their "health, physical, mental and moral development" ("age-inappropriate content");
- how design features could cause addiction.

Every year, VLOPs and VLOSs need to identify and assess the potential online risks for children and young people using their services. Just as there is an age-rating for films in the cinema, some online content and services are not appropriate for younger age groups. Therefore, platforms will also put measures in place to mitigate these risks, including (as appropriate, depending on the platforms):

- Parental controls:
  - Settings that help parents and carers, for instance, monitor or limit children's access to the internet, to protect them from online risks and inappropriate content.
- Age verification:
  - A system to check the age of users before they access the service, for instance, based on physical identifiers or other forms of identification.
- Tools:
  - To help young people signal abuse or get support.

Overall, the goal of the DSA is to ensure platforms implement best practices and follow relevant guidance on how to keep their young users safe.

7.2.2 Artificial Intelligence Act

The EU AI Act gives explicit attention to children as a vulnerable category [i.36] and [i.37]. In Recital 28a clarifies explicitly that "children have specific rights as enshrined in Article 24 of the EU Charter and the United Nations Convention on the Rights of the Child (further elaborated in the UNCRC General Comment No. 25 as regards the digital environment), both of which require consideration of the children's vulnerabilities and provision of such protection and care as necessary for their well-being".

The AI Act classifies in Annex III for Article 6 classifies all uses of AI in education as high-risk any use of educational AI could heavily impact young people's life chances or life outcomes for example the scoring of exams.

High-risk AI systems are subject to strict obligations before they can be put on the market:

- adequate risk assessment and mitigation systems;
- high quality of the datasets feeding the system to minimise risks and discriminatory outcomes;
- logging of activity to ensure traceability of results;

- detailed documentation providing all information necessary on the system and its purpose for authorities to assess its compliance;
- clear and adequate information to the deployer;
- appropriate human oversight measures to minimise risk;
- high level of robustness, security and accuracy.

Narrow exceptions are strictly defined and regulated, such as when necessary to search for a missing child and those usages is subject to authorisation by a judicial or other independent body and to appropriate limits in time, geographic reach and the data bases searched.

7.2.3 European Cyber Resilience Act (CRA)

The Cyber Resilience Act (CRA) [i.56], is a piece of European Union legislation that governs the cybersecurity of products with digital elements distributed on its territory. It directly complements other legislative pieces such as the AI Act or the NIS2 Directive.

The CRA officialises the responsibility of manufacturers, and in some cases importers and distributors, for the digital security of the products they put on the market. They now have no choice but to think about and guarantee the digital security of their products throughout their entire lifecycle, from the earliest stages of design to the end of the support period.

Under the CRA there is a category known as important products of Class 1 and Class 2. A product is considered important if meets at least one of the following two criteria:

- The product primarily performs functions critical to the cybersecurity of other products, networks or services, including securing authentication and access, intrusion prevention and detection, endpoint security or network protection.
- The product performs a function which carries a significant risk of adverse effects in terms of its intensity and ability to disrupt, control or cause damage to a large number of other products or to the health, security or safety of its users through direct manipulation, such as a central system function, including network management, configuration control, virtualisation or processing of personal data.

Under class 1 products includes personal wearable products to be worn or placed on a human body that have a health monitoring (such as tracking) purpose or personal wearable products that are intended for the use by and for children.

For Class I, manufacturers can choose whether they confirm via a cybersecurity standard (not yet specified which one, for example ETSI EN 303 645 [i.48]) or via 3rd party assessment.

7.3 Regulation

7.3.1 General Data Protection Regulation (GDPR)

The General Data Protection Regulation (Regulation (EU) 2016/679) [i.49], is a European Union regulation on information privacy in the EU and the European Economic Area (EEA). It also governs the transfer of personal data outside the EU and EEA. The GDPR's goals are to enhance individuals' control and rights over their personal information and to simplify the regulations for international business.

There are a few key provisions that businesses, organisations and service providers need to be aware of when concerning the data of children [i.38]:

- Art. 8 GDPR Conditions applicable to child's consent in relation to information society services. *In relation to the offer of information society services directly to a child, the processing of the personal data of a child shall be lawful where the child is at least 16 years old. Where the child is below the age of 16 years, such processing shall be lawful only if and to the extent that consent is given or authorised by the holder of parental responsibility over the child. Member States may provide by law for a lower age for those purposes provided that such lower age is not below 13 years. They shall make reasonable efforts to verify in such cases that consent is given or authorised by the holder of parental responsibility over the child, taking into consideration available technology.*

- Recital 38 Special Protection of Children's Personal Data. Children merit specific protection with regard to their personal data, as they may be less aware of the risks, consequences and safeguards concerned and their rights in relation to the processing of personal data. Such specific protection should, in particular, apply to the use of personal data of children for the purposes of marketing or creating personality or user profiles and the collection of personal data with regard to children when using services offered directly to a child. The consent of the holder of parental responsibility should not be necessary in the context of preventive or counselling services offered directly to a child.

- Recital 58 The Principle of Transparency. Given that children merit specific protection, any information and communication, where processing is addressed to a child, should be in such a clear and plain language that the child can easily understand.

- Recital 65 Right of Rectification and Erasure. That right is relevant in particular where the data subject has given his or her consent as a child and is not fully aware of the risks involved by the processing, and later wants to remove such personal data, especially on the internet. The data subject should be able to exercise that right notwithstanding the fact that he or she is no longer a child. Though are some exceptions to this for example on the grounds of public interest in the area of public health, for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes, or for the establishment, exercise or defence of legal claims.

7.3.2 NIS2 Directive

The Directive (EU) 2022/2555 [i.50] on measures for a high common level of cybersecurity across the EU, known as NIS2, sets out a common cybersecurity regulatory framework aiming to enhance the level of cybersecurity in the European Union (EU), requiring EU Member States to strengthen cybersecurity capabilities and introducing cybersecurity risk-management measures and reporting in critical sectors, along with rules on cooperation, information sharing, supervision and enforcement.

It applies principally to medium-sized and large entities operating in sectors of high criticality. When it comes to children and adolescents, they would broadly come under critical sectors defined in Annex II for digital providers of online marketplaces, search engines and social networks. While the measures outlined in the directive do not explicitly refer to children as they will likely be user of online marketplaces, search engines and social networks the digital providers should consider or investigate any specific requirements or needs that might differ from a typical adult user. This will be under the four aver arching areas covered the by the NIS2 directive of risk management, corporate accountability, reporting obligations and business continuity.

8 Security, Data Protection and Privacy

8.1 Introduction

There is an abundance of material covering these topics in general [i.39]. This clause will focus on key points relevant to children. For example, this includes design considerations, education, and awareness which also includes teachers and parents. The provision of links to information resources. It should be noted these points can also be applied to vulnerable adults.

8.2 Cybersecurity

Cybersecurity is just as critical for young people as adults. Though the risks and harms will differ. The common cybersecurity breaches that users may experience are:

- Phishing - unsolicited emails and fraudulent messages that seek to trick the recipient into providing private information.

- Malware is software that gets downloaded onto your device to cause harm and is often downloaded through links in messages and emails.

- Identity theft - stealing identity information that allows the criminal to commit fraud or other crimes.

The focus for children is cybersecurity education. It should include strategies children can use to protect themselves and their private information:

- Passwords - Children should be taught from an early age not to share passwords and to learn to create strong passwords that cannot be easily guessed.
- Privacy - Children should be taught how to understand privacy settings on online services, so their personal information is not available to strangers.
- Browsing Safely - Children should be aware of how to identify safe websites and avoid suspicious pop-ups and downloads.
- Email Safety - Children should learn to avoid downloading unsafe attachments and not click on suspicious links.
- Children should fully understand how they can report any concerns they may have regarding cybersecurity at school or home.

8.3 Data Protection

When the personal data of children is collected additional protection is as children are less aware of the risks and consequences of sharing data and of their rights [i.38]. Any information addressed specifically to a child should be adapted to be easily accessible, using clear and plain language.

For most online services the consent of the parent or guardian is required in order to process a child's personal data on the grounds of consent up to a certain age. This applies to social networking sites as well as to platforms for downloading music and buying online games.

The age threshold for obtaining parental consent is established by each EU Member State and can be between 13 and 16 years.

Companies have to make reasonable efforts, taking into consideration available technology, to check that the consent given is truly in line with the law. Preventive or counselling services offered directly to children are exempted from the requirement for parental consent as they seek to protect a child's best interests.

8.4 Online Safety

8.4.1 Overview

Ensuring children understand online safety is essential because many of them will be using a wide range of technologies in their home environments, even before they start school. Technology is becoming an integral part of children's lives; it entertains them, engages them and motivates them.

Safety advice for younger children should be age-appropriate, simple and understandable. Establishing the right pitch from the outset is essential so that children are not unnecessarily scared or confused.

The clauses that follow cover some of the topics that can affect the online safety of children. Also, this advice applies to adults in general as well.

8.4.2 Parental Controls

Parental controls are designed to help protect children from inappropriate content online, such as pornography or other adult content. These controls can be used in a number of ways, e.g. to help ensure that your children access only age-appropriate content, to set usage times and to monitor activity.

Four main places often have parental controls, and it can help to set up a combination of these:

- Internet provider: It is possible can set up filters to help block access to inappropriate content on any device that connects to the home WiFi®.

- Mobile operator: Filters are often automatically set up on mobile contracts, especially if the user is under the age of 18, but this should be double-checked with the provider.
- Devices: Many devices have parental control settings, for example, to help restrict spending in apps, reduce screentime, or disable location functions.
- Online Services: Often media sites have parental control settings to help restrict access to inappropriate content.

It is also important to remember that parental controls are not 100 % effective. For example, if parents have parental controls from their internet provider on their home WiFi®, these will not cover the use of 3G, 4G or 5G at home. Similarly, if their child goes to a friend's house where there are no controls in place, they may be able to access unrestricted content. It is important for parents to have the knowledge and tools to be able to talk and discuss with their children about their online activities to be able to create a safe environment online or when they see something inappropriate online and need to talk about it.

8.4.3 Report Button

Ideally, it is important that places online where people spend time together are safe and fun for everyone. This means everyone needs to follow the rules and be respectful to others. If something online worries, upsets or confuses a user they should be able to report this so an online safety team or moderator can investigate and if need be, take the appropriate action.

A user can report different things and for different reasons. For example:

- A player or user who has done something wrong.
- A post which does not follow the site rules or is upsetting.
- A comment on a post - for example, if someone is being unkind or bullying.

All of the information in a report will be sent off to the safety team of the site or app being used. The content reported will be looked at to decide if it breaks the site rules. The report should be able to attach evidence to help explain what happened such as screenshots. Reporting should be anonymous. The person who has been reported should never be told who reported them.

If a report shows someone has broken the rules, the safety team can take action like:

- Deleting upsetting posts or comments.
- Giving users a warning about their behaviour.
- Suspending users' accounts for a short amount of time.
- Removing users from the platform entirely.

If it does not, this should be explained to the user, and they may be given some other advice on what to do next.

8.4.4 Online Sextortion

Sextortion is a type of blackmail when someone threatens to share nudes, semi-nudes, sexual information, or videos of someone unless the victim pays money or agrees to do something else, such as share more images. Sextortion is a crime and can be committed by individuals or by a group of people working together.

Criminals often target people through social media, dating apps or video calls. The criminal might get the photos and videos by:

- Tricking someone into believing they were sharing them with someone they could trust.
- Taking screenshots from video calls or livestreaming without the person realising or consenting.
- Stealing them though hacking an account.
- Using digitally manipulated images, including AI-generated images.

- Sometimes the criminal will pretend that they have intimate images even if they do not.

When sextortion is reported it is important to remember not to blame the victim as it is not their fault. Help the victim in saving any evidence such as screenshots of any messages or information they have been sent and do not delete the chat until it is appropriate to do so. Help them in stopping communications. Do not pay any money or accept the extortioners demands.

If there are nude images of the victim being shared there are tools available where they can report a nude image or video of themselves. When they report the content, processes are put into place to take it down.

8.4.5 Online Sexual Harassment

Online sexual harassment is any unwanted sexual behaviour that occurs online. It can happen on any online platform and could include content such as photos, videos, posts, web pages, messages or fake profiles. Even if the harassment was intended as a joke, or was a misunderstanding, it is the experience of the victim that defines whether it is sexual harassment or not.

There are a couple of keys measures to be able take. First, block. Blocking stops the harasser from being able to message their target or see the things they post in future. Second, report. Ensure the app, game or site knows what has happened and to be able to provide any evidence.

8.5 Online Privacy

Today, children are growing up in a digital world; being online and using digital services is an integral part of their lives where they learn, play and connect with others. However, the online world was not designed with children's needs in mind and, as a result, the potential for harm is ever-present.

Children may be less aware of the risks, safeguards and their rights about the use of their information. There are risks that if organisations fail to use children's information properly, for example it could leave them vulnerable to:

- being inappropriately identified or targeted by strangers;
- having their location tracked; or
- being sent harmful communications.

There are a few key measures organisations should take in the following areas to reduce the risk of harm from privacy being compromised [i.40]:

- Children's profiles should be private by default and geolocation settings should be turned off by default. As the ability to track a child's location information risks it being misused to compromise their physical safety or mental well-being.
- Children's profiles should have targeted advertisements turned off by default unless there is a compelling reason to use profiling. Children may not be aware that their information is being gathered or that it can be used to tailor the adverts they see. This may impact children's autonomy and control over their personal information. It could lead to financial harm, where adverts encourage in-service purchases or additional app access without adequate protections in place.
- Limit or avoid using children's information in recommender systems. There are risks of algorithmically generated content feeds creating pathways to less suitable content, potentially including self-harm, suicide ideation, misogyny or eating disorders.
- Obtaining consent to use personal information. Depending on the country, children under a certain age (commonly 13) cannot consent to an online service processing their personal information; parental consent is required. For example, services may require that a children's profile is linked to a parent's profile and they may use age assurance technologies to assess the age of the user and apply appropriate protections.

9 Conclusions and Recommendations

9.1 Overview

Conclusions are based on reviews of relevant literature, surveys of media coverage of issues, stakeholder reports and published guidance from industry and academia. Specific recommendations have been highlighted in bold text below. This present document did not initiate laboratory studies or surveys of user groups.

9.2 Design Issues

- Children, as ICT users, are, in most respects, differently abled than their adult counterparts. Only if their abilities, needs, and requirements are studied, understood, and differentiated can well-working, understandable, and accessible ICT solutions be offered.
- It is recommended that:
  - the analytical approach described in clause 5 of the present document is recommended as a conceptual and procedural framework for the development of distinct sets of guidelines for:
    a) product designers;
    b) service developers; and
    c) standardization organizations;
  - representative descriptive studies of ICT use among children should be encouraged and promoted.
- Gender and cultural differences (including language) should be considered for children's product and service design.
- Guidelines for product evaluation for children need to be tailored to children.
- Children instinctively share their experiences. A better understanding of this process is needed in order to design better products and services.

9.3 Market Issues

- A better understanding of the market for ICT products for children and its characteristics is needed. The market's transient nature makes it difficult to market relatively high-priced products to children and their parents.
- It is recommended that:
  - regular studies of the market for ICT products for children should be undertaken;
  - technology that grows with the child is needed. Developers as well as parents are generally unwilling to invest in expensive technology toys and ICT devices that are discarded after a short period. They expect them to last longer enough for a child to outgrow it and may be handed down to a younger sibling multiple times.

9.4 Health and Safety Concerns

- Smartphones can pose several health and safety concerns for children, including:
  - Mental health: Excessive smartphone use can lead to anxiety, depression, and loneliness. Children are also vulnerable to cyberbullying, which can have detrimental effects on their mental health.
  - Sleep disturbances: The blue light emitted from smartphones could interfere with sleep patterns.

- Eye strain: Prolonged screen time could cause eye fatigue and increase the risk of myopia.
- Obesity: Screen media exposure is associated with increased eating while viewing.
- Concerns about the potential vulnerability of children to radio-frequency electromagnetic radiation (RF-EMR) fields is increasing as children's exposure to wireless devices is on the rise. Children are considered potentially more vulnerable to RF-EMR fields because of the susceptibility of their developing nervous system.
- Inappropriate content: Children could encounter inappropriate content, including violence and explicit material, while using smartphones.
- Reduced face-to-face interaction: Excessive phone use could lead to reduced face-to-face social interactions.
- Privacy concerns: The sharing of personal information and the potential for online privacy breaches could lead to stress and anxiety.

Two key steps to help keep children safe include parental controls on the child's smartphone and setting guidelines for their use.

There are different steps and measures available, to help ensure a child's ICT workplace is tailored to match the physical dimensions and ergonomic requirements of children. These also apply to adults. These include:

- Desk setup: The desk should be supportive but allow for movement. A desk with adjustable height can accommodate growth. A tilted desk can help prevent slouching.
- Monitor and keyboard position: The monitor should be at eye level and directly in front of the child, at least arm's length away. The keyboard should be in a fully flat position for typing. For long periods of typing, a raised monitor and external keyboard can help prevent neck and shoulder strain.
- Mouse position: The mouse should be at the same height as the keyboard and close to the side of it. Use your whole arm, not just your wrist, when using the mouse.
- Posture: Children may not be aware of their posture, so it is important for adults to notice and correct it.
- Breaks: Take frequent breaks to relieve stress and avoid computer vision syndrome and physical disorders.

9.5 Security and Privacy Concerns

- Age verification mechanisms independent of identity are needed and are being developed in response to the EU Digital Services Act:
  - European standardization bodies and activities investigating and/or proposing identity verification schemes are determining the need for reliable age verification mechanisms that do not compromise the online anonymity of children. ETSI TR 104 077-1 [i.42] Age Verification Pre-Standardisation series exemplifies this.
  - Using information of children under 13 years old. Generally, children under the age of 13 cannot consent to their data being used by an online service, and parental consent is required instead. How services gain consent, and how they use age assurance technologies to assess the age of the user and apply appropriate protections, are important for mitigating potential harm.
- Default privacy and geolocation settings. The ability to ascertain or track the location data of a child creates risks, including potentially having their information misused to compromise their physical safety or mental well-being. This is why children's profiles should be private by default and geolocation settings should be turned off by default.
- Profiling children for targeted advertisements. Children may not be aware their personal information is being collected, or that it can be used to tailor the adverts they see. This may impact children's autonomy and control over their personal information, and it could lead to financial harm where adverts encourage in-service purchases or additional app access without adequate protections in place. Unless there is a compelling reason to use profiling for targeted advertising, it should be off by default.

- Using children's information in recommender systems. Content feeds generated by algorithms may use information such as behavioural profiles and children's search results. These feeds may create pathways to harmful content such as self-harm, suicidal ideas, misogyny or eating disorders. The design of recommender systems may also encourage children to spend longer on the platform than they otherwise would, leading to children sharing more personal information with the platforms. Ideally, recommender systems should avoid doing this.

9.6 User Interface Design Issues

- Help facilities, guidelines, manuals and documentation for children need to be better understood and produced. There are ETSI documents which guide user interface design issues: ETSI EG 203 499 [i.43] User-centred terminology for existing and upcoming ICT devices, services and applications; ETSI TR 103 852 [i.44] An Examination of Video Game Useability and Accessibility; ETSI TR 101 550 [i.45] Accessibility requirements suitable for public procurement of:
  - ICT products and services in Europe;
  - ETSI TR 103 349 [i.46] Functional needs of people with cognitive disabilities when using mobile ICT devices for an improved user experience in mobile ICT devices;
  - ETSI EG 203 350 [i.47] Guidelines for the design of mobile ICT devices and their related applications for people with cognitive disabilities;
  - ETSI EG 202 848 [i.51] Inclusive eServices for all;
  - ETSI TR 101 568 [i.52] A study of user context dependent multilingual communications for interactive applications.
- The specific benefits for children of common interactive elements in mobile user interfaces should be investigated and explored empirically. The availability of common, basic interactive elements increases the transfer of learning between devices and services and improves the overall usability of the entire interactive mobile environment. Such a transfer becomes even more important in a world of ubiquitous devices and services. Simplifying the learning procedure for end-users will allow for the reuse of basic knowledge between different terminal devices and services and lead to faster and easier adoption of new technologies, fully benefiting the end user without restricting the manufacturer's wish to use user interfaces based on a corporate look-and-feel and the overall user experience as a competitive edge.

NOTE: Examples [i.1] of such basic elements, some of which may be relevant for children, are: International access codes, emergency functionality and services, symbols, icons and pictograms, acoustic signals, access to basic voice services, basic terminology, text entry and retrieval, assistive device interfaces, UIs of services and applications, configuration procedures, service and application access, service and application terminology, structure and vocabulary of spoken commands, address book data format and portability, terminology of network services, universal addressing in converging networks, positioning services, service and content presence, connectivity and adaptability and user privacy and security.

9.7 General Accessibility Issues

In general ICT devices and services should comply with the European Accessibility Act, a directive that aims to improve the functioning of the internal market for accessible products and services by removing barriers created by divergent rules in Member States.

These covered products and services include:

- computers and operating systems;
- ATMs, ticketing and check-in machines;
- smartphones;
- TV equipment related to digital television services;
- telephony services and related equipment;

- access to audio-visual media services such as television broadcasts and related consumer equipment;
- services related to air, bus, rail and waterborne passenger transport;
- banking services;
- e-books;
- e-commerce.

Children make use of many of these products and services.

To that end, the requirements of the standard are self-scoping. This means they consist of two parts; the first part is a precondition for the second part, which holds the actual requirement. If a product or service meets the precondition, then the product or service will conform to the second part of the requirement.

Also, applicable is ISO 9241-210 [i.53]:2019 [i.53] on Ergonomics of human-system interaction, which provides requirements and recommendations for human-centred design principles and activities throughout the life cycle of computer-based interactive systems. It is intended to be used by those managing design processes and is concerned with ways in which both hardware and software components of interactive systems can enhance human-system interaction.

It should also be noted that a designer can go beyond the requirements in ETSI EN 301 549 [i.54] these are design for all [i.8] and universal design principles [i.5]. This includes design principles such as:

- Provide the same means of use for all users: identical whenever possible; equivalent when not.
- Avoid segregating or stigmatizing any users.
- Provisions for privacy, security, and safety should be equally available to all users.
- Provide choice in methods of use.
- Eliminate unnecessary complexity.
- Provide compatibility with a variety of techniques or devices used by people with sensory limitations.

Design for all and universal design principles do go beyond what is required from current accessibility legalisation. They are ideal recommendations but not a requirement.

9.8 Proactive issues

The implications of anticipated future products and services need to be understood. Examples of such systems are communicating, social media networks, smart toys, image sharing (messaging apps and the internet), video sharing platforms and AI systems:

- Technology and service development activities need to be monitored to try to anticipate and evaluate their impact on children. This includes online safety, the impact on children's mental health and development due to always online connectivity and the impact of the metaverse, MR/AR/VR as they continue to develop.
- Specifically, the implications of 5G/5G Advanced/6G (smartphones) need to be regularly reviewed from the perspective of usability, content control and algorithmic marketing.
- Speech interfaces are very appropriate for pre-literate children and children who lack the strength and coordination skills needed to use other types of input devices, but these are not designed for young children. Research on speech interfaces that consider the vocal qualities of children should be undertaken. Paired with the effect touchscreens have on fine motor control development.

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