

## **Critical aspects of demand in the Assistive Technology market in Europe**

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The demand for Assistive Technology products is considered through a methodological approach which provides a framework for the analysis of selected aspects of the Assistive Technology (AT) market. Throughout the paper, the AT market is considered from a socio-economic perspective; as a system which is considerably influenced by demographics. This allows the application of systems dynamics in order to analyse the elements, activities and actors influencing demand in AT and to consolidate the results into a conceptual model facilitating the study and empirical investigation of demand determinants.

# Critical aspects of demand in the Assistive Technology market in Europe

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## ABSTRACT

The demand for Assistive Technology products is considered through a methodological approach which provides a framework for the analysis of selected aspects of the Assistive Technology (AT) market. Throughout the paper, the AT market is considered from a socio-economic perspective; as a system which is considerably influenced by demographics. This allows the application of systems dynamics in order to analyse the elements, activities and actors influencing demand in AT and to consolidate the results into a conceptual model facilitating the study and empirical investigation of demand determinants.

## KEY WORDS

Filtered demand, Revealed demand, Intermediaries, Demand determinants

## INTRODUCTION AND BACKGROUND

Two key factors which have had a profound impact on society and have influenced demographic changes are the rapid technological advances and the dramatic improvements in medical treatment and care. Both have led to a reduction of the mortality rate of disease or accident stricken patients, and have contributed to a general increase of life expectancy of the population at large. These effects have, in turn, precipitated a significant increase of the proportion of the population that is characterised by some handicap with respect to the surrounding environment, either as a consequence of some impairment resulting from disability, or as a consequence of some impairment resulting from old age.

Recent studies of life expectation at birth and at 65 are helpful not only for statistical purposes (i.e. predicting the numbers who will survive to 65) but also in providing an indication of the demographic shape of population over the next twenty years in Europe and elsewhere in the world [2]. The emphasis on demand and its determining factors is justified by the intention of this paper to consider the domain of the Assistive Technology market from a socio-economic perspective [16]; as a system which is considerably influenced by demographics. Inevitably, demand/supply type of analysis is required to bring light to this interaction. Additional reasons which make the study of demand in this field relevant and necessary are : (i) the growing size of the population which may require Assistive Technology goods in the future; (ii) lack of knowledge about critical issues which currently influence or may potentially influence the demand for Rehabilitation Technology goods; (iii) clarification of the role of intermediaries, particularly in the cases where their interest may differ from the interest of the end-user;

(iv) identification of areas for potential intervention leading to a better understanding of end-user needs and requirements by the actors involved.

This paper will examine the influential role of some of the above factors with the view to establish a conceptual tool for the analysis and empirical investigation of the demand for Assistive Technology products. The paper is structured as follows. The next section identifies related work and describes the normative perspective of the paper, which is to consider the elements, activities and actors influencing demand in Assistive Technology. Then next three sections review each one of these with the aim to identify the type of intervention and influence that they exhibit, in the context of demand. The next section consolidates the findings and develops a conceptual model of demand in the AT market. It is claimed that this model provides a powerful mechanism for identifying and empirically investigating critical demand determinants of an AT product.

## **RELATED WORK AND PROBLEM DOMAIN**

In [1] a framework for modelling selected aspects of the Rehabilitation Technology market has been described in terms of a set of relevant elements and their interrelationships. The work reported in this paper is one instance of the application of this framework in the context of the demand for Rehabilitation Technology products.

Moreover, in [9] a conceptual tool, namely the Rehabilitation Technology product taxonomy, has been proposed for addressing several issues related to this market (e.g. selecting Assistive Technology products, subject to criteria, for detailed analysis, focusing the conscious search of Assitive Technology actors for innovation opportunities, determining product characteristics, etc). This conceptual tool takes the form of a taxonomy and consists of a set of four categories of criteria (see [9]), namely, market structure related criteria, economic environment, product based criteria and technology related criteria.

In the context of this work, the Assistive Technology product taxonomy serves a twofold purpose. First of all, it helps identify and extract some general dynamic, rather than static demand determinants. Secondly, it facilitates the identification of product specific determinants of potentially high explanatory value.

## **ANALYSIS OF THE MARKET ELEMENTS INFLUENCING DEMAND**

In [1] a market element is defined as a market component influencing demand and/or supply. Moreover seven market elements were identified in the context of the European Assistive Technology market, namely, research, development, production, trade, procurement, service delivery and usage. Market elements have a considerable impact on the nature, type and level of demand for a particular product. The demand for a product of a firm may be influenced by several of the market elements, with more prominent the elements of service delivery, trade, procurement and usage (see Figure 1). This is because irrespectively of the method of provision of a Assistive Technology product (i.e. on-loan, free of charge, etc), some sort of financing, trading, delivery, installation and usage will always take place. In the following paragraphs, each of the above elements are considered in terms of their influential role and impact on the demand for Assistive Technology products.

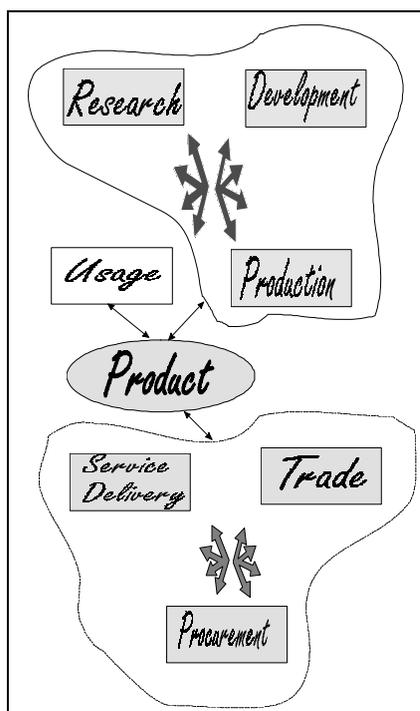


Figure 1 : Market elements dominating the demand for AT products

Service delivery and trade are important because they embody the notion of *third party intervention* [5], [8]. In most countries, third party intervention takes place in a number of ways. Usually, however, following medical examination, the individual is provided with an official certificate of medical condition. This certificate is issued by a doctor or, in some cases, by a committee of doctors affiliated to a state supervised insurance organisation. Subsequently, and subject to the approval of an application, a technical aid can be provided from any (specialised) commercial outlet. Usually, such commercial outlets are responsible for the installation and training of the end user. However, depending on the structure of the service delivery system (i.e. whether centralised or decentralised) the demand for a particular product may

be considerably influenced. For example, in centralised service delivery systems with generally low level of trade, installation, training and later repairing of a particular aid may be associated with considerable time delays, resulting in the dissatisfaction of the end user.

Procurement often becomes a predominant market element influencing both the demand for and supply of Assistive Technology products and services. The lack of funding for a particular product group has frequently been reported as the primary counter stimulating factor restricting market development and growth [7], [9]. Of course, procurement is also a multivariate function influenced by many factors including financial and social policies and target population size. It is also evident that in certain cases there is a strong inter-correlation between some of the determinants of procurement. For example, lack of financial support is often associated with low levels of demand irrespective of the potential size of the target population. This is evidenced in the case of certain product classes. For instance, despite the high percentage of the total population who may be potential users of alarm systems, only a few countries have devised policies covering technical aids within this product group.

Usage is one of the elements which has a profound impact on the demand for Assistive Technology products. This is mainly attributed to the fact that the vast majority of actors active in this element are all consumers of technical aids. Such actors may be generally classified into the following broad categories: (a) end users (disabled and elderly people); (b) families and relatives of end users; (c) user associations or federations, mainly concerned with advising other consumer groups; (d) Rehabilitation professionals involved in the preventive, curative or rehabilitative sectors and who have been given by law the right to assess end users and prescribe technical aids; (e) universities and research and development institutes and (f) hospitals. They all constitute the Assistive Technology consumer group. Consequently, it becomes apparent that end users are by no means the sole consumer of technical aids. The importance of this finding is that prices may not be determined as described in the traditional theory of demand

where it is explicitly assumed that consumers of a product are only the end users of this product [10]. It is then possible to appreciate the various special price agreements between producers and consumers and their impact on consumption and demand. Another important consequence arising from this broad range of consumer groups is the oligopolistic behaviour of firms in the market which, in turn, has serious implications on the type and intensity of competition, pricing mechanisms, competitive strategies, and the type and direction of innovation.

## ANALYSIS OF THE PROCESSES INFLUENCING DEMAND

By identifying the relevant processes or activities, (the two terms are synonymous), which substantiate, filter and ultimately fulfil demand for Assistive Technology products, we can specify and characterise the determinants of demand in this market. A first attempt to categorise the Assistive Technology market processes is depicted in Figure 2. The diagram also provides an overview of the current problem facing users and manufacturers of technical aids (i.e. a vicious cycle whereby users do not know what is available, while manufacturers lack detailed knowledge about end users requirements) and some of the relevant high level processes that they are involved in. A distinction is made between processes relating to the demand for and supply of Assistive Technology goods respectively. In what follows, we concentrate on a brief analysis of

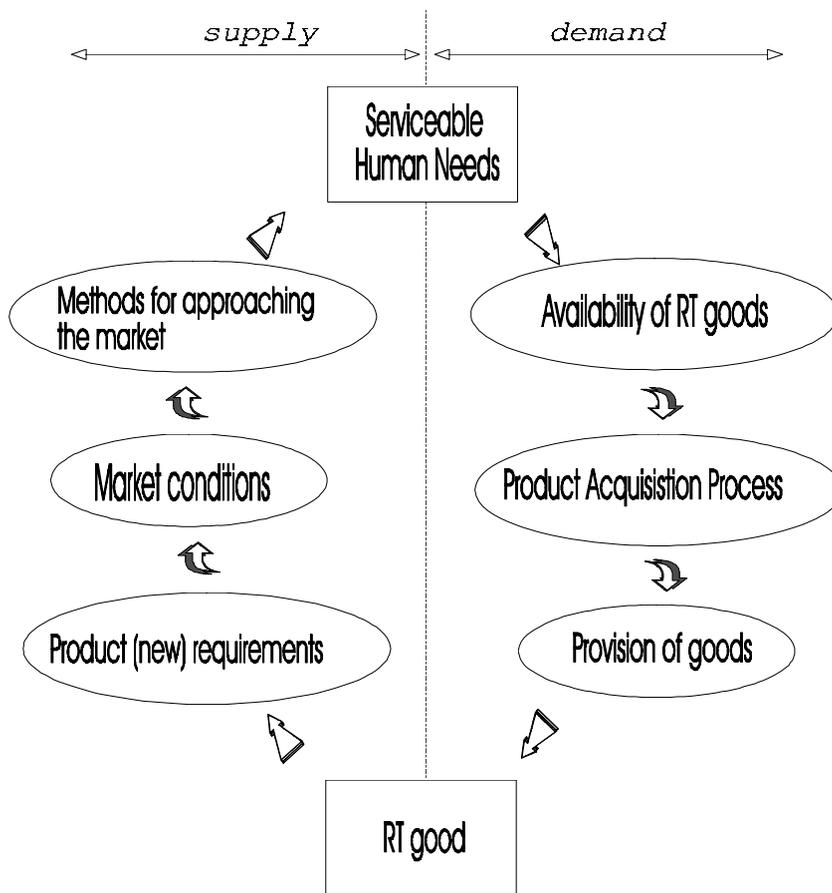


Figure 2 : Aggregate processes influencing the demand for AT products the three activities depicted in the right part of the diagram of Figure 2, and which predominate the demand for Assistive Technology products and services. Our objective will be to shed light into the various elements and factors of these activities which

currently influence demand. Subsequently, this will allow us to consolidate the results into a conceptual model of demand in Assistive Technology.

### **Product and Service availability**

Product/service availability refers to the inquiry of finding out what is available in the market place. The availability of such information is of paramount importance to all actors in the Assistive Technology market and especially those who are directly involved in the assessment of client needs and the prescription of a solution. One aspect which is inherent in this process is the assumption of appropriate information possession by the relevant actors. However, the limited form in which information is presently disseminated (mainly paper printed) causes several problems for all parties involved, restricts consensus and raises numerous questions about awareness.

### **Product acquisition**

Following the product/service availability inquiry, the product/service acquisition processes are initiated in order to facilitate the functional assessment of the client, as well as the selection and provision of a technical aid to the end user. These steps are briefly elaborated below.

Functional assessment constitutes the predominant type of intervention by third parties, and plays a crucial role in determining the type and level of demand. At the core of functional assessment is the filtering of human needs (i.e. the interpretation of end user requirements as well as the prescription of devices by expert professionals). Such "filtering" leads to the conclusion that demand for Assistive Technology products is usually *revealed* as opposed to *actual* demand, while it may accommodate a *private* and *public* component. Public demand, is largely "filtered" demand and covers all products supported by a national provision system whereas private demand includes products which may be acquired in the free market.

Filtering of consumer needs may be an iterative process involved in both the demand and supply of technical aids. From the supply-side, filtering usually takes the form of special agreements (e.g. on price, delivery) between certain consumer groups or intermediaries and suppliers. From the demand-side, the process is triggered off once a special need is realised. Subsequently, a functional assessment is carried out which defines the handicap's boundaries. The next stage is concerned with establishing a mapping between the functional requirements as revealed through the functional assessment and the range of assistive devices which can be used. The term *need-driven but filtered demand* is used to reflect the *goodness of fit* of this mapping. In other words:

$$\text{Filtering} : R_f \rightarrow R_t$$

where  $R_f$  stands for functional requirements while  $R_t$  stands for technical requirements. Nevertheless, it is important to note at this point that much of the rehabilitation work is still performed by professional's who "know best" what the needs of people with disabilities are. These practises are, in certain cases, linked with professional interests which often overshadow the interests and preferences of the end user.

For the purposes of this paper, the above practical view can be formalised through the introduction of the human-task interface model. This model, which is depicted in Figure 3, can be considered as a model of functional limitation from the human-task interface point of view.

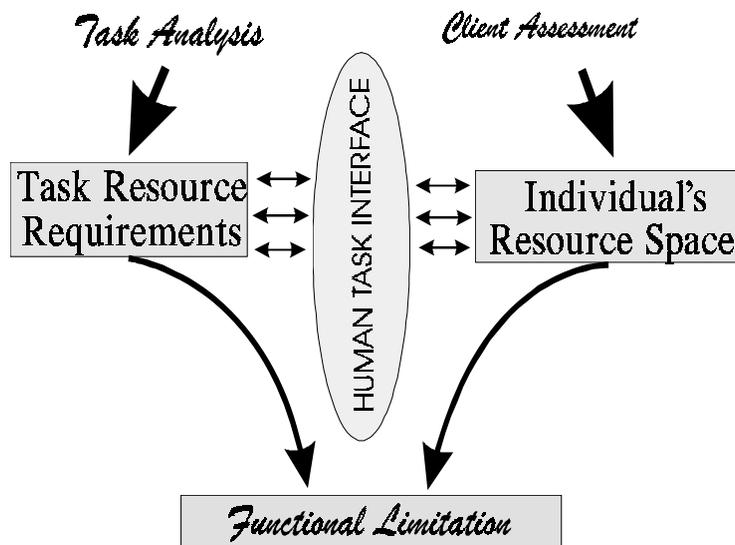


Figure 3 : The Human - Task Interface model

An important issue associated with this model is the introduction of two concepts, namely task analysis and client assessment, both of which play a key role in the context of functional assessment. Task analysis refers to the definition of the task's *resource requirements*. These are requirements, typically demanded on behalf of an individual in order to successfully carry out this task. For example, the task for accessing information through a Graphical User Interface (GUI) usually demands from the user to be capable of effectively operating a pointing device (i.e. the mouse), which in turn, may require eye-movement, hand movement and eye-hand co-ordination and visual tracking. On the other hand, the client's assessment focuses on the user. It defines the user's *resource (or action) space* in terms of the requirements that the user can supply towards the successful completion of a task. Referring to our previous example, client assessment of a motor impaired user amounts to identifying that the user may not operate the mouse. Demand for resources, as identified in the task's analysis, compared to supply of resources on behalf of the user defines the area of functional limitation.

Task analysis and client assessment as abstract concepts related to the original needs of users which constitute the demand for technical aids and services. However, as already stated, such demand is seldom addressed because of the filtering process which intervenes. Instead, it is filtered demand which drives the market. Tracing through the "human-task interface" model, it can be deduced that functional limitation(s) can be influenced through variations of either the task's resource requirements or the client's supply of resources or both. Such variations can be achieved via the assessment and prescription of the appropriate Assistive Technology solutions (see Figure 4). For the purposes of our previous example, such a solution may involve the provision of the user with a foot-operated switch as well as certain modifications in the User Interface of the application in order to accommodate this interaction technique.

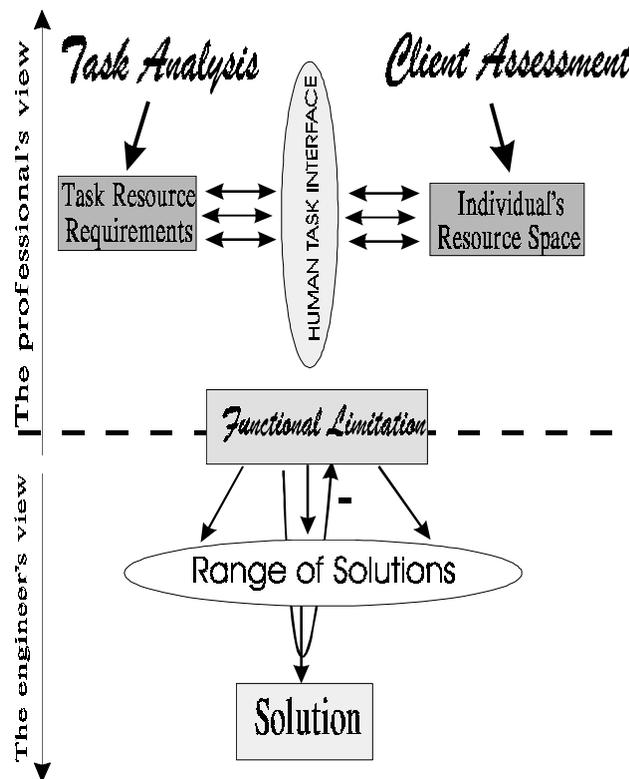


Figure 4 : Assistive devices and the Human Task Interface model

Assistive Technology solutions usually serve the purpose of either replacing some missing function or assisting the user in the execution of a function which is not adequately performed as a result of the functional limitation. Typically, they may involve the prescription of some technical aid in its generic form, an adapted product, an environmental adaptation<sup>1</sup> or a combination thereof.

The negative feedback loop identified in the lower part of the diagram of Figure 4, between the functional limitation and the Assistive Technology solution, suggests that as Assistive Technology solutions become functionally and technically more advanced the functional limitation or the resulting relative handicap(s) may be reduced or eliminated. The feedback loop introduces directly the notion of information exchange between users and manufacturers for better specifications and design guidelines for final products. Therefore, functional and technical advancements in the production of assistive devices can only be relevant if they incorporate the user's opinion and degree of satisfaction or dissatisfaction in the use of the assistive device.

From the discussion on the Human-Task Interface model so far, it becomes apparent that all possible actions (i.e. Assistive Technology solutions) aim to relocate the dynamics of the entities of the model towards a more desirable equilibrium state. This relocation is typically influenced by decisions and actions of trained personnel who may use a pseudo systematic and subjective approach (with the exception of only a few types of technology) and less frequently by the end user. From this viewpoint, success depends on the professional's expertise in assessing the client, the breadth of knowledge regarding the availability of solutions and the knowledge of requirements for utilising a particular solution.

<sup>1</sup> Environmental adaptation refers to the actions taken towards a more accessible environment.

Notwithstanding this, it should be stated that the goodness of fit between functional and technical requirements will also depend on additional factors such as education and training of the parties involved, the quality of task analysis and client assessment, the user's involvement and competence as well as the availability and quality of the assistive devices at the market place. In addition, many other factors may become relevant during the search for a solution. Such factors relate to regulation, existence of legislation acts, financing the solution, standardisation and so forth. They will also be addressed at a later stage.

### **Provision, installation and training**

The next relevant process aims to identify the providers of products and services who operate the services or produce, manufacture, distribute or sell technical aids. They may be insurance companies, user organisations, government agencies, industrial firms or other commercial outlets. In the course of this investigation, the end user, is usually advised by various parties, namely health professionals, rehabilitation specialists or user organisations. It is therefore critical to emphasise their role as intermediary organisations.

In many cases, installation and training reflects a process which may substantially influence the dynamics of demand. In particular, the end users competence about a device is generally influenced by past experience, which may be hindered by inappropriate installation and/or training. Although it is commonly accepted that different devices usually call for different installation and training procedures, this is often neglected for Assistive Technology products.

A very general categorisation of Assistive Technology products reflects the classification into tools and appliances (see footnote 2). Typical examples of appliances are Personal Response Systems and hearing aids, whereas wheelchairs are representative of the tool category. The classification of a product as either a tool or an appliance is critical for all parties concerned, as each category calls for quite different approaches during installation and training of end users.

An indicative differentiation between a tool and an appliance accounts for the fact that in the case of an appliance, the user must be trained how to operate the device, whereas in the case of a tool, the user must be trained not only how to operate the device but also how to use it effectively. For example, in the case of wheelchairs the user must be trained both how to operate the device as well as how to operate it effectively. In the case of alarm systems, or personal response systems the user can only be trained how to use the device since effective operation depends on the quality of the local telecommunications service.

Consequently, the abstraction *user-device*, when considered as a system, functions slightly differently in the two cases as the user's involvement and decision space vary. Failure, on behalf of the intermediary, to realise such critical issues may raise end user dissatisfaction and influence the pattern and level of demand for the product of a firm.

## **THE ACTORS INFLUENCING DEMAND**

Although the Assistive Technology market is characterised by a broad range of non-homogeneous consumer group, the main recipient of Assistive Technology services are disabled and elderly people. Consequently, the end user's involvement in a technical aid's life cycle, namely feasibility, development, design, implementation and evaluation stage, is critical if the aid is to serve its purpose successfully. On the other hand, user's

involvement has traditionally been limited due to several factors (i.e. lack of education, training, and the lack of direct interactions between the end user and the manufacturer), thus frequently, permitting the intermediary, in this case the Rehabilitation specialist, predominate the product selection process.

Ideally, disabled and elderly people should be highly motivated, knowledgeable and financially independent in order to be able to engage and influence the negotiations towards the selection of a particular product. But in fact, it is very unusual for a user to possess these attributes severally and in sufficiency to ensure active involvement or influential participation in the various decision-making activities of any provision system.

In general, the decision about the solution for a particular user can be influenced by various other parties such as :

- medical doctors and health professionals;
- rehabilitation professionals;
- end users;
- family of the end user or relatives.

Co-operation amongst all parties should ideally be the desirable means for ensuring that the appropriate solution is chosen and prescribed to the end user. However, there are many factors which may restrict this co-operation or the outcome of the co-operation and in such cases the client/agency relationship breaks down [7], [8], [9]. Such factors are:

- the kind of solution regarded as appropriate by the relevant parties;
- the user's cultural level;
- the user's motivation to undertake challenges of independent living;
- financial restrictions, etc.

In [9], it was argued that several factors may influence the user's involvement; one of them being the type of product considered appropriate. Furthermore, it was suggested that to describe and analyse such causal relationships, alternative constructs may be utilised. Indicatively, some of them can be found in the description of the Rehabilitation Technology product taxonomy proposed in [9]. More specifically, it can be shown that the user's decision space is largely dependent upon the degree of the user's dependency upon the device. In other words, the user's decision space is a function of the purpose of the device. Consequently we may derive:

$$User_{\text{decision\_space}}: \phi (\text{Device})$$

where  $\phi$  implies the purpose of a particular device.

It may further be argued that equally important are the quite different levels of skill and competence required by the respective users of the two products, in order for them to be able to appreciate the technological characteristics of each product and their respective use. We can then summarise that:

$$Usage = \theta (l (User) , s (User) , \phi (Device) , t (Device) )$$

$l$  = expectation level,  $s$  = skill,  $\phi$  = purpose of a device and  $t$  = type of device.

It can be said that the *skill*,  $s$  of a particular end user is a function of experience and training, while *type*,  $t$  reflects whether the device is a tool or an appliance<sup>2</sup> and  $\phi$  the

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<sup>2</sup>An appliance is a type of product whose underlying technology operates nearly independently of the user and, as a result, the effective use of the product is not controlled by the user; a tool on the other

purpose of the product (i.e. whether it aims to replace a function or assist the user in the performance of a function). As shown later, the type of device has important implications on the training of the user and the use the device is put by the end user.

It can therefore be seen that the professional may be required to play a twofold role, namely an advisory role and frequently the role of the decision maker. A prerequisite for the professional, to be able to play such a key role, is "well-structured" and "all-around" knowledge of the Assistive Technology market. Unless such a condition is met, there is a higher risk of subjective judgement by the Rehabilitation professional or the intermediary actor in general, which in turn may give rise to a situation of *conflicting interests between this intermediary actor and the end-user*. This highlights the requirement for formal education and continuous training in the light of recent developments.

Upgrading of existing knowledge, in the light of recent technological developments, however, is an issue which may be critically assessed. In particular it is important to analyse the relationship between the rate of technological development and specific variables whose influence is critical. A statement of issue, is therefore, whether or not knowledge resulting from technological development is effectively communicated to the wider spectrum of interested users, (people with special needs or professionals).

Today's highly fragmented and oligopolistic Assistive Technology market does not facilitate the effective communication of research results (i.e. technological development) amongst the relevant actors. In particular, the rehabilitation professional often finds himself in a position where he is not fully aware or able to appreciate the distinctive attributes of different solutions which can be made available to the client<sup>3</sup>. Thus, the professional should be fully aware of the specifications of particular devices, their recent or potential modifications as well as solutions which involve environmental adaptation and control.

Additional factors, some of which have already been mentioned, may influence the selection of the Assistive Technology solution. Moreover, it would be interesting to examine some of them in relation to the rate of technological growth and its resulting effects. For example, user competence associated with the rate of technological development; skills demanded upon the user to operate certain Assistive Technology products especially as they become technologically more advanced; education is also considered as a means for raising user competence and skills possessed with respect to recent technological advances, etc. Despite, the interesting issues involved in analysing such factors, they will not be further elaborated here, since such a treatment lies beyond the scope of the present work. However, their value and influence on a wide spectrum of issues should not be underestimated.

The preceding discussion reveals that an important aspect of the European Assistive Technology market is the *client-agency* relationship which dominates the demand for Assistive Technology products. The *client* in this context is the consumer<sup>4</sup> or

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hand is a product whose effective operation is usually dependent on the user. Note that the "tool-appliance" construct can be applied either at the level of the product or at the level of a part or function of a product, with considerable implications for the design and launch strategies of the product.

<sup>3</sup> A "solution", in this context refers to an existing technical aid, modified technical aids and adaptations.

<sup>4</sup>and this group as already pointed out is not restricted to the end users of Rehabilitation Technology products and services.

the user of a device, whereas an *agency* may be a medical doctor, a health specialist, a rehabilitation specialist, a user organisation or an insurance organisation. The important conclusion arising from this discussion is the apparently unequal distribution of power amongst the client and the agent, which results in the relatively stronger position of the latter.

### ANALYSIS AND DISCUSSION OF THE FACTORS INFLUENCING DEMAND

Synthesising a consolidated overview of the issues discussed so far, it is argued that demand for Assistive Technology products and services may be determined by: (i) third party interventions and filtering of consumer needs; (ii) population characteristics; (iii) some exogenous factors such as standardisation, legislation, and social policy (see Figure 6). Final demand is composed from a private and a public demand component. Public demand is usually "filtered" demand, mainly due to the existence of intermediaries.

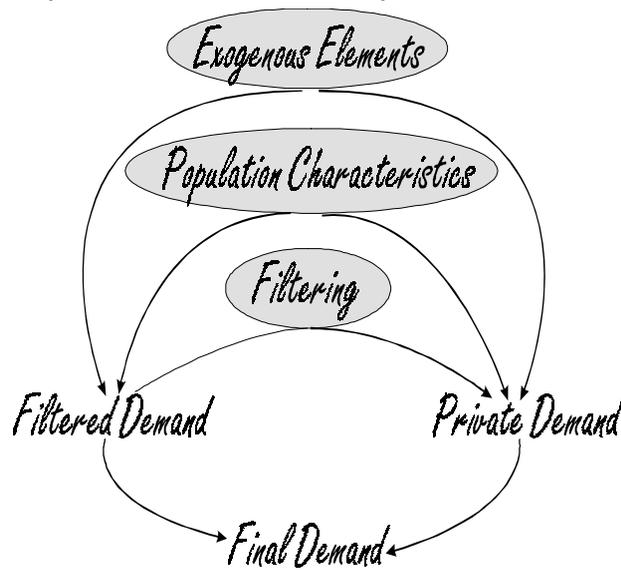


Figure 6 : Classes of potential demand determinants

Consequently,

$$\text{Demand}_{\text{final}} = \text{Demand}_{\text{filtered}} \cup \text{Demand}_{\text{private}}$$

In other words,

$$\text{Demand}_{\text{final}} = \{ \varphi_1, \varphi_2, \lambda(\varphi_3, \varphi_4, \varphi_5), \varphi_6 \}$$

and

- $\varphi_1$  = Variables depicting filtering
- $\varphi_2$  = Population-specific variables
- $\varphi_3$  = Variables depicting the role of standardisation
- $\varphi_4$  = Variables depicting the role of legislation
- $\varphi_5$  = Variables depicting the role of policy
- $\varphi_6$  = Product-specific variables

The above three sources of influential factors are considered as a superset of demand determinants in the context of Assistive Technology goods. They constitute a conceptual framework for dynamic demand analysis. This is to say that the above categories of sources of demand determinants are likely to give rise to factors which may be irrelevant for some specific product or analysis. Consequently, depending on the domain of a particular study, the proposed framework provides a solid basis for

constructing a theory of the demand of this product. Although not explicit, the framework embodies (the potential for identifying) both general and product-specific demand determinants. Depending on the role of filtering for example, price and disposable income may be considered as general demand determinants. On the other hand, population characteristics and product based criteria (as specified in the Assistive Technology product taxonomy) are the source for identifying product specific demand determinants. A general hypothesis characterised the approach being proposed is that product specific demand determinants are of relative higher explanatory value than general demand determinants.

In conclusion, the determinants of demand and consequently the criteria to be selected for the product taxonomy, should be carefully evaluated in order to derive an optimum set of qualitative influential factors describing, evaluating and/or predicting demand for a particular product.

### **A. Third party interventions and the filtering of end user needs and requirements**

A distinctive characteristic of the present state of the Assistive Technology market in Europe, is the interventions of third-party payers (e.g. insurance organisations) or other intermediary organisations. These are individuals or organisations who have been given by law the task to assess disabled or elderly people and prescribe solutions.

The immediate consequences of such interventions are the *filtering* of consumer needs and requirements and the apparent preference of such intermediary organisations to deal with a few of the larger companies rather than with many small ones. A statement of issue is, therefore, that the decision of what technical aid the consumer is likely to be prescribed is largely a function of an interpretation of the consumer needs by an intermediary actor.

Due to the influential role of intermediaries and the filtering of consumer needs, final demand in the Assistive Technology market has two components, namely filtered and private demand. Total consumption is composed by both private and filtered demand. Moreover, as a result of the structural characteristics of the market and the Assistive Technology actors, in conjunction with some supply related issues<sup>5</sup>, consumption (of Assistive Technology goods) is determined by private consumption (of Assistive Technology goods) and public sector consumption (of Assistive Technology goods). Private consumption (of Assistive Technology goods) includes both local consumption and exports; for both income per capita is a strong determinant.

### **B. Population characteristics as determinants of demand**

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<sup>5</sup>these supply-related issues have been elaborated in Draft Deliverable No. 4 and include competition type (i.e. products imported to / exported from a particular market) and intensity, market structure, production focus and low rate of specialization, etc.

Certain population characteristics have been evidenced to be dominant demand determinants in existing socio-demographic models [16]. Such determinants are birth and death rates whereas in some cases quality of life is also included. Consequently, in the

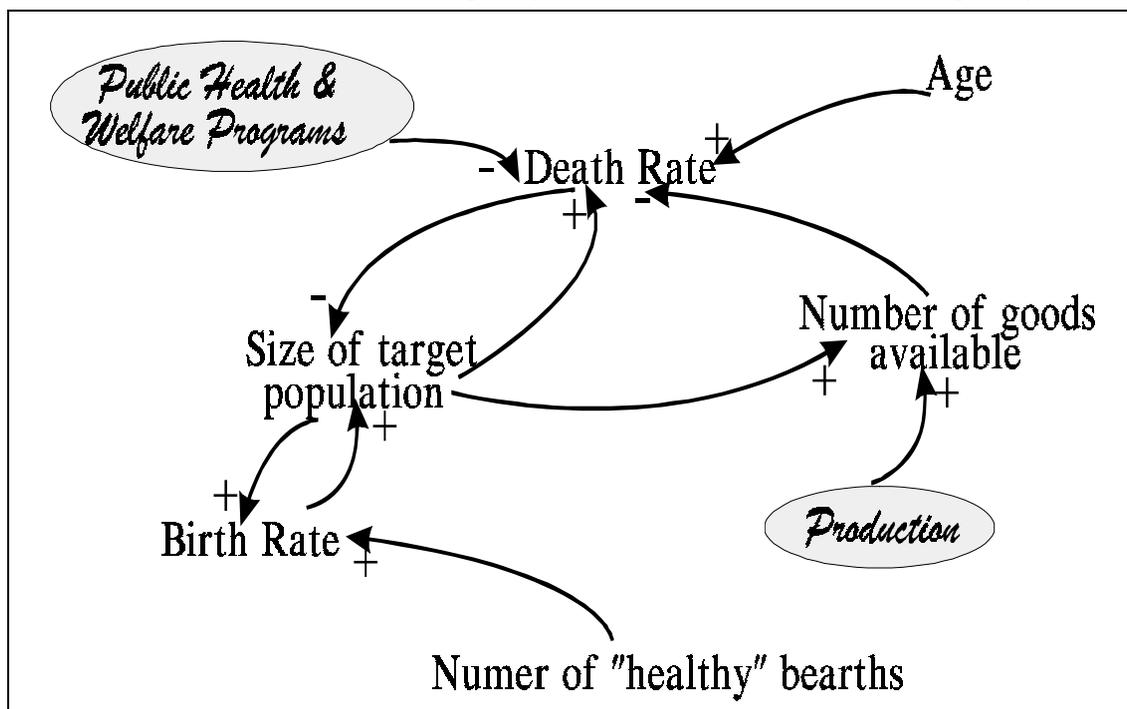


Figure 7 : The determinants of the target population size

context of the disabled and elderly population, the above variables in addition to ageing are the basic endogenous factors influencing the size of the disabled and elderly population (see Figure 7).

Any formal treatment of the determinants of the size of the disabled and elderly population should indicate whether population is considered as aggregated or desegregated population. Although our discussion will assume aggregated population, it is appropriate to indicate some of the factors which permit the adoption of a desegregated view of disabled and elderly population.

Thus, this population can be desegregated according to age, impairment, disability, handicap, economic class, sex, location, type of support required, etc. In particular circumstances, it may be useful and necessary to consider a relevant subset of these factors in defining the desegregated disabled and elderly population.

Referring to Figure 7 and assuming the determinants of the size of the target population depicted in this diagram as endogenous elements of the model, it could be argued that the death rate may be influenced by higher income *per capita*, by exogenous government investment on services, financial and social policies, etc. This would alter our reference causal diagram as shown in Figure 8.

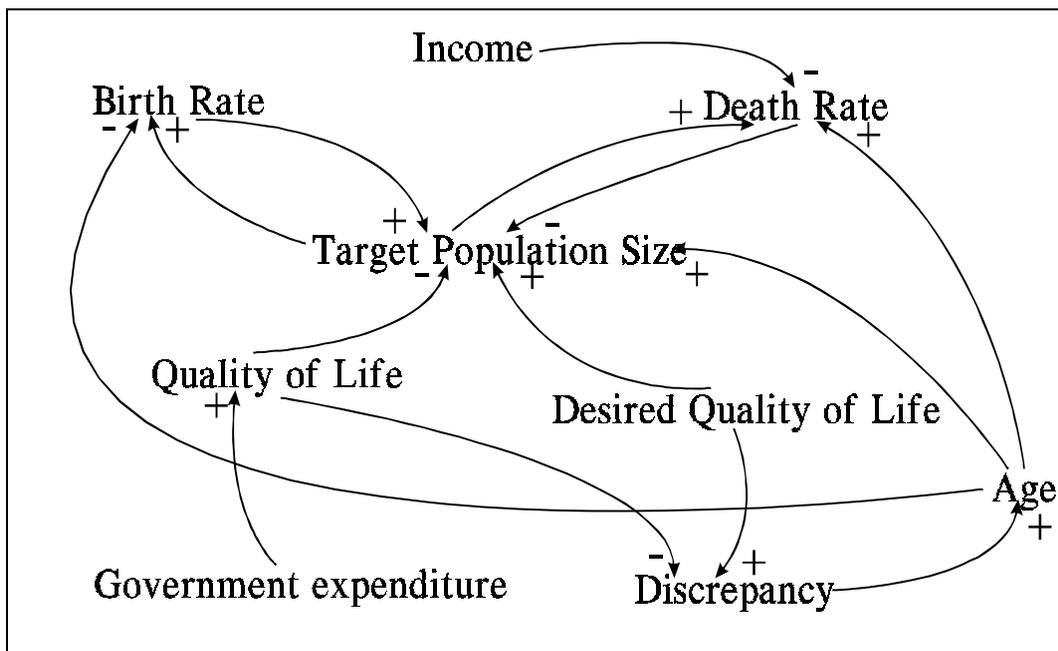


Figure 8 : Revision of the determinants of the target population

It is therefore evident that depending on certain conditions, income *per capita* could potentially influence the size of the disabled and elderly population. Consequently it would be appropriate to examine the relationship between income and demand. It has been implicitly suggested that purchasing power (i.e. income *per capita*) may not always be a determinant of demand since Assistive Technology goods or a relevant subset of them are typically covered by national insurance schemes and provision systems. Figure 9, depicts the role of income in determining the growth of the disabled and elderly population. However, choosing higher income *per capita*, as the element for influencing the growth of the population of disabled and elderly people, may not result in a substantial increase in the demand for Assistive Technology products, unless the products are not covered by a national scheme for health and/or welfare. In other words, in a country where the national provision system, through the application of appropriate legislation, public/financial/social policy, covers a substantial percentage of Assistive Technology goods, the private demand for Assistive Technology goods may be only a small percentage of final demand for Assistive Technology products and services. In such a case private Assistive Technology consumption will be only a small percentage of the total consumption of Assistive Technology goods. Consequently disabled and elderly population growth through higher income *per capita* may not stimulate a corresponding increase in the demand for Assistive Technology products and services, indicating that alternative interventions may be required.

The above argument may not necessarily hold when the target population is desegregated and a particular category of product is considered (e.g. the case of alarm systems, a product which is not usually covered by a national insurance scheme). In such cases the argument could be formulated as suggested in the diagram of Figure 9 with the exception that purchasing power would now become a stronger determinant of demand. In support of this diagram, the distinctive characteristic of the alarm system users (existing and potential), as reported in the relevant literature (see [11]), are the strong influence of age on attributes of this population such as size, motivation, competence, expectation level, etc. As reported in [17], there is evidence to suggest that age is the factor which demonstrates the strongest link with consumption of social services and

health/medical services. This finding indicates that population as depicted in Figure 9 is mainly influenced by the negative feedback loop between death rate and population, since death rate is directly related to age. Nevertheless, other factors are also relevant such as the public health and welfare programmes, the availability of appropriate Assistive Technology goods and disposable income, as indicated earlier.

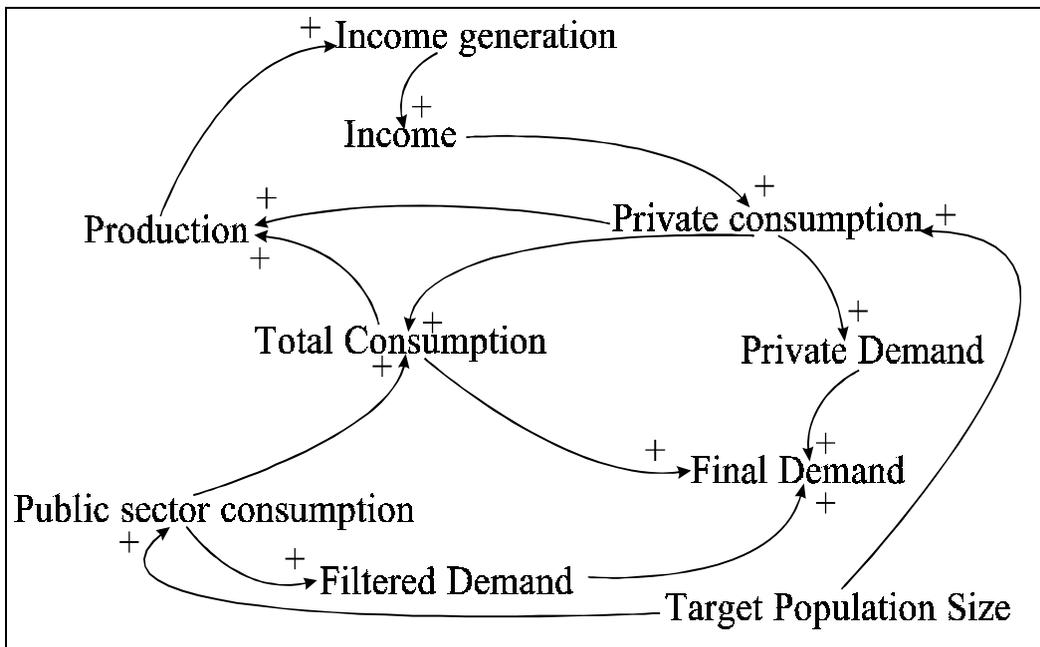


Figure 9 : The role of income in determining target population growth

Although elderly people occupy a large percentage of the alarm system users, disabled people of all ages are also frequently encountered as users or potential users or people in need of such goods [12]. Moreover, it has also been reported that additional issues may determine the use of Assistive Technology goods such as alarm systems (e.g. cultural issues, type of accommodation, the relative location of the carer and the cared-for, party expressing the demand, etc)<sup>6</sup> [7]. Some additional factors characterising the target disabled and elderly population and the demand for Assistive Technology products are depicted in Table 2.

Table 2 : Additional factors which may influence the demand for a specific product

- Adaptability of product to meet individual needs
- User competence
- Type of product and associated requirements for user training
- Testing applied to the product and standardisation

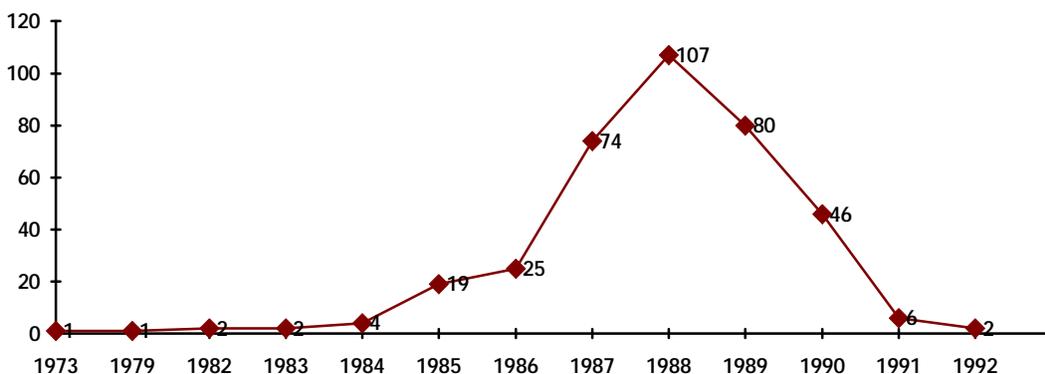
<sup>6</sup>In particular, for the case of Personal Response Systems (PRS), there is evidence to suggest that in many countries there are more than one type of PRS to choose from, namely PRS for private housing which are also privately acquired, and intercare PRS for sheltered housing whose provision may vary. The different kinds of PRS usually result in different operating costs. For example, intercare PRS usually operate on an internal telephone network so that the user does not have to pay for the calls. Frequently such type of differences are the only ones observable. Moreover, the technical specifications of the installed products are more or less the same, irrespective of the type of PRS.

- Ergonomic and other aesthetic aspects
- Ease of product maintenance
- Availability of accessible information

### C. Additional exogenous factors which may influence demand

Any meaningful analysis of demand for Assistive Technology products would have to draw attention on some general exogenous (for the purposes of this work) factors or policy variables such as standardisation, legislation and financial/social policy. Existing evidence supports this view and reinforces the belief that the above policy variables constitute necessary tools towards the promotion of Assistive Technology products and the elevation of the level of demand in this field. In Finland for example, this view is fully substantiated in the context of alarm telephones. As shown in the diagram of Figure 10, the introduction of legislation in 1984 stimulated higher level of demand for the alarm telephone service.

Consequently, it is worth briefly examining some of the aspects related to standardisation, legislation and policy in the context of the European Assistive Technology market.



*Table adapted from TIDE-CORE Deliverable No. 5*

Figure 10 : The demand for the alarm telephone service in Finland.

## SUMMARY AND CONCLUSIONS

This paper has investigated the demand for Assistive Technology products. Its purpose, as already stated, is to determine the various factors that affect demand, through a thorough and targeted investigation following the principles of a the formal framework for modelling selected domains of the Assistive Technology market. Summarising, our investigation has revealed that the demand for Assistive Technology products and services is mainly determined by:

- third party interventions and filtering of consumer needs;
- population characteristics;
- some exogenous factors such as standardisation, legislation, and social policy.

The above three sources of influential factors are considered as a superset of demand determinants in the context of Assistive Technology goods. This is to say that the above categories of sources of demand determinants are likely to give rise to factors

which may be irrelevant for some specific product or analysis. To complement and target the analysis of demand in the context of some specific product, the Assistive Technology product taxonomy has been used. This taxonomy is a conceptual tool consisting of a set of criteria, namely market, product, and technology specific criteria. Consequently, it is imperative that depending on the domain of a particular study, the determinants of demand suggested by the above categories, and consequently the criteria to be selected for the product taxonomy, should be carefully evaluated in order to derive an optimum set of qualitative influential factors describing, evaluating and/or predicting demand for a particular product.

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