

# Part I

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**Aim and scope:** To communicate and complete knowledge on ICT, AT and Accessibility for/with people with disabilities and older adults and connect research in these domains with the necessary practical background and user related aspects.

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# Promoting Labour Market Inclusion

## A Review of Assistive Technologies for Workers with Autism Spectrum Disorder

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**Abstract.** Persons with autism spectrum disorder (ASD) can be efficient workers. Despite the increasing recognition of their potential contribution in the workplace, they continue to experience many challenges entering and maintaining employment. Overcoming these challenges can be achieved by resorting to specific assistive technologies (ATs) which can play, if properly chosen, a strategic role in allowing persons with ASD to compete with all others in accessing, hiring, maintaining employment. It is in the light of these considerations that this contribution aims at deepening knowledge in this field by investigating which ATs can be used in the workplace to support the labour market inclusion of persons with ASD. This study provides a focused systematic review of 27 studies identified within the literature. Results analyzed the ATs that can be used for supporting the labour market inclusion of persons with ASD, the skills they help to develop and the work activities they can support.

**Keywords:** Assistive Technology, Autism Spectrum Disorder, Labour market inclusion

## 1 Background

Persons with autism spectrum disorder (ASD) can be efficient workers [3,4,9]. Several research carried out on the employment of these persons revealed that, despite the difficulties connected to this neurodevelopmental condition disorder, they are able to tolerate repetitive tasks for a short time, carry out the assigned jobs with a high degree of precision, and accuracy, maintain high levels of attention for long periods and be particularly precise in the technical field. [3,19,24]

Despite the increasing recognition of the potential contribution that persons with ASD can bring in the workplace, they continue to experience many challenges entering and maintaining employment [11,12]. Higher unemployment rates comparing to those of persons with other types of disabilities, high percentage of temporary contracts, works in positions below their qualifications or skill level, working reduced hours and lower rates of pay than their co-workers in comparative positions represents some of



the main features characterizing the labour market of persons with ASD [15,12,25,23,10,17].

The lack of social and communication skills, poor time management, inappropriate commenting, poor hygiene, deviating from routine, difficulties with reasoning, decision-making, mastering the job application process, remembering and following instructions, interacting and communicating effectively with co-workers and integrating into the workplace culture are some of the main barriers that hinder or prevent persons with ASD to enter the labour market, to find and maintain a job, to be included workplaces [14,19].

These barriers can be overcome by introducing in the workplace specific reasonable accommodations; these undoubtedly include assistive technologies (ATs) which can play, if properly chosen, a strategic role in allowing persons with disabilities to compete with all others in accessing, hiring, maintaining employment, in carrying out the assigned job duties and in career advancement [6].

Despite the growing recognition of their strategic importance, there are still few research that have investigated the field of ATs for persons with autism spectrum disorder in the workplace [23].

The scarcity of studies in this field entails, in several countries including Italy, the persistence of a non-use or under-use of the potential of ATs for workers with ASD and other kind of disabilities [6]. Research conducted in this area shown that employers' workplace ATs knowledge is rather poor [13,16,17,7,20] and many of them have the perception that ATs for workers with ASD are excessively expensive and complex to adopt and manage [17].

All these factors often lead employers to look at ATs with distrust and to be hesitant about their adoption [7]. In some cases, they can also lead to making bad choices and moving towards ineffective solutions to meet the needs of people with ASD and the needs of work contexts [20].

It is in the light of these considerations that this contribution aims at deepening knowledge in this field by investigating which assistive technologies can be used in the workplace to support the labour market inclusion of persons with autism spectrum disorder.

## 2 Method Used

To compose an overview of the state of the art of ATs for persons with autism spectrum disorder (ASD) in their day-to-day work a systematic review was conducted in November 2021. The electronic databases *Psych INFO*, *Education Resources Information Centre* (ERIC), *Scopus*, *Psychology and Behavioral Sciences Collection* (EBSCO) were investigated using the following keywords: *assistive technolog\* AND employment AND worker\* with autism spectrum disorder OR worker\* with autism*. No time limit was entered. The title and abstract of retrieved studies were then reviewed for inclusion using the following inclusion/exclusion criteria: (a) the study must have included worker(s) with ASD; (b) participants, with a diagnosis of ASD, must have been 18 years of age or older; (c) the study must have reported AT(s) for promoting/managing

employment/job tasks; (e) the study must have been published or accepted for publication with online availability in English within a peer-reviewed journal. Each included study was then summarized using a reading form to collect information about: (a) AT used; (b) developed skills; (c) related work activities/job tasks.

### 3 Results and Discussion

A total of 1216 articles was retrieved; of them 27 met the inclusion criteria for the review (see Fig. 1).

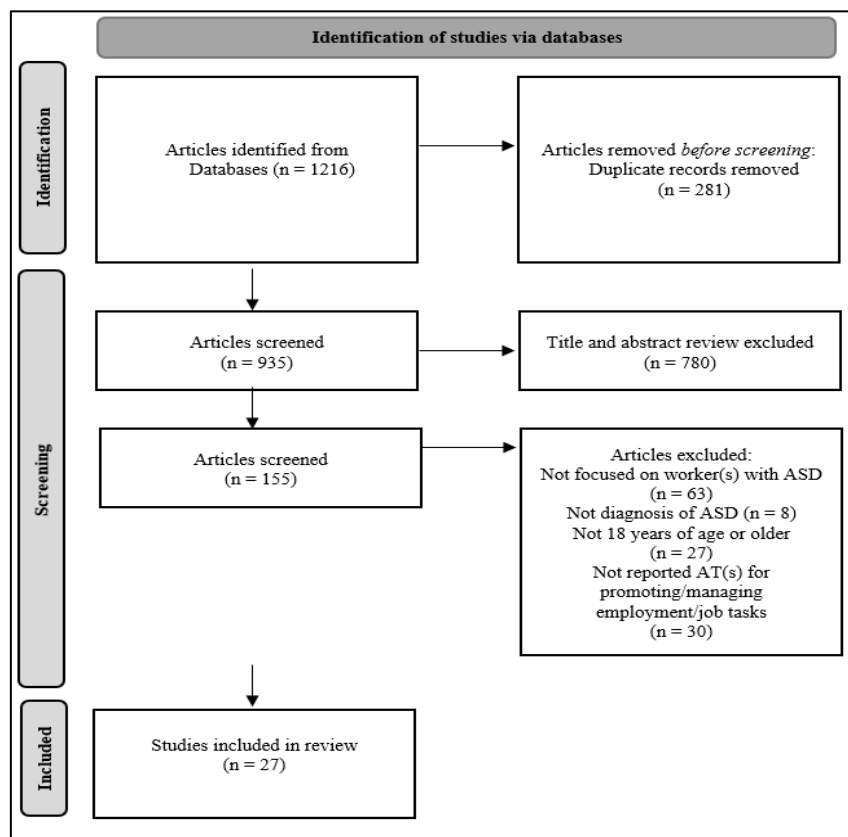


Fig. 1. Search process flow diagram

The included articles<sup>12</sup> were published from 2003 to 2021; most of them (20 out of 27) was in the time frame from 2012 to 2021, highlighting a growing interest and development in this field especially in recent years.

<sup>12</sup> The references of the included articles are: [3,5-7,10-15,17-21,23-29,32-36].

### 3.1 ATs Used

Table 1 provides an overview of the founded assistive technologies.

**Table 1.** Assistive Technologies reported in the included studies

Technology	Number of studies	References
Radio and headset	1	[3]
iPod, iPad, iPhone	13	[5,10,13-15,19-21, 24, 33-36]
Tablet	3	[6,14,17]
Laptop computer	6	[7,12,23,26,28,29]
Pocket PC	1	[32]
Virtual reality	2	[18,27]
Wearable	1	[25]

Radio and headset are used in the covert audio coaching (CAC). This is a method for giving antecedent prompts and performance feedback using a pair of two-way distance radio. This implies the presence of a job coach or a mentor providing assistance, job explanations and feedback [3].

Although only a paper reported this technology, CAC can be used in various work environments where the use of radio technologies (headsets, etc.) is increasingly frequent; it lends itself well to concise messages such as instructions and timely feedback that are useful for learning the skills necessary to carry out work tasks, reduces the dependence of the person with autism on the presence of a specific operator and the risk of misrepresenting forms of non-verbal communication that characterize communicative exchanges in presence [3].

iPods, iPads, iPhones (13 out of 27) are the most frequently found technology in the included studies. Their portability and ease of use makes them increasingly popular within work contexts and as part of job training and internship programs for workers with autism spectrum disorder [10,24]. However, what makes these mainstream technologies assistive are the different and more and more numerous software that can be installed allowing iPod, iPad, iPhone to become Personal Digital Assistants (PDAs) [5,36].

PDAs are conceived to provide the person with stimuli, prompts for the note, of a visual, auditory, or combined nature [25]. These stimuli can reproduce specific sequences of actions or be memoranda that serve the person to learn, or remember, all that is necessary to perform one or more work tasks or to develop skills and competences to interact with work colleagues or participate in conversations and conferences [34]. PDAs are pocket-size, easily accessible, and economical when compared to other solution, and allow workers with ASD to acquire skills to carry out tasks autonomously, progressively reducing the dependence on personal assistants [11].

PDAs represent one of the most common interventions to support workplace inclusion of workers with ASD [5].

PDAs can also be composed through PCs and tablets even if their use is limited and were found in few of the studies included in this review. Their reduced diffusion is mainly attributable to their size which makes them less portable than iPod, iPad, iPhone

which can be held in the hand or inside clothing pockets. For this reason, their use is limited to work situations characterized by a sedentary lifestyle such as office work at the computer or at a desk.

In addition to these ATs, a promising approach is the possibility of customizing workplaces, thanks to information communication technologies (ICT) and the internet of things (IoT) expanding the still untapped potential of virtual reality and wearables such as smartwatches [18,27,25]. This approach represents a fascinating perspective on ATs but is still too complex and expensive [30].

### 3.2 Developed Skills

In the selected studies, assistive technologies were used to support the development of different kinds of skills in workers with autism spectrum disorder.

Specifically, three macro types of skills can be identified: 1) pre-vocational skills, namely «the basic skills and abilities essential for employment in any field, such as following directions and being punctual»<sup>13</sup> (e.g., social skills, communication skills) [32-34]; 2) generic on-the-job skills (e.g., participating to a job interview, preparing a job application) [18,27]; 3) specific on-the-job skills (e.g., answering the phone, photocopying) [19,24,18,27].

The assistive technologies identified can support the development of these skills by 1) teaching to workers with ASD through video modelling [32-34]; 2) supporting the memorization of the sequences of actions necessary to carry out a work task providing auditory and visual antecedent prompts [19,24]; 3) giving job performance feedback [3]; 4) simulating job situations and work tasks using virtual reality [18,27,25].

Although the different assistive technologies can all be functional to the development of the different types of skills mentioned above, some possible trends in the choice of assistive technology in relation to the skills to be developed in the worker with autism spectrum disorder seem to emerge from the literature in this field.

Tablet and Laptop computer on which various types of software can be installed, appear to be useful for supporting, through video modelling, the development of pre-vocational skills. iPod, iPad, iPhone, Wearable are used, always in combination with software that make them Personal Digital Assistants, to support the development of specific on-the-job skills. The same happens, but without the use of software as they make use of the remote presence of a tutor, using Radio and headset. Finally, the use of virtual reality production systems appears to be of growing interest to support development of generic on-the-job skills.

### 3.3 Related Work Activities / Job Tasks

Within the articles included in this review, assistive technologies were used to teach workers with ASD to carry out different jobs or labour market related activities (i.e., participating a job interview).

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<sup>13</sup> APA Dictionary of Psychology (<https://dictionary.apa.org/prevocational-training>) [21/01/2022].

It should be noted that the studies mainly referred to the use of assistive technologies for workers with ASD in the fields of public administration, office work [7,12,23].

The analysis of the different studies highlighted how the use of assistive technologies to support the labour market inclusion of persons with ASD requires that each job task be carefully analyzed and divided into specific and detailed sequences of actions. This is a fundamental step as it allows you to identify the appropriate auditory and visual prompts, plan feedback and program video modeling software [3] [25].

## 4 Conclusions

This systematic review allowed to deepen the ATs knowledge for workers with autism spectrum disorder. Expanding knowledge in this field is strategical for supporting the labour market inclusion of persons with ASD, especially in Italy.

In fact, in our country, the absence of a national database collecting and disseminating the different ATs and reasonable accommodations adopted by employers, make workplace assistive technologies a hard-moving universe, unlike other countries where some national databases in this field are operational, such as the Job Accommodation Network in the United States.

However, a further element for reflection must be brought to attention: an in-deep knowledge of assistive technology itself is not enough to achieve workplace inclusion. In fact, ATs represent a useful tool that can unfold its potential if properly selected and inserted within a personalized workplace inclusion project, integrated with the broader life project of the person with disabilities [1,2,8].

This requires companies to have an in-depth knowledge not only regarding disability, assistive technologies, labour laws, reasonable accommodation, but also related to humanities like pedagogy and psychology.

It is an indispensable knowledge to allow companies to define objectives, strategies, activities, appropriate tools, and evaluating methods for designing a project capable of responding and balancing the needs of the person with ASD and those of the workplace, so to improve their labour market participation and inclusion.

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