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To cite this article: Malcolm MacLachlan & Marcia J. Scherer (2018) Systems thinking for assistive technology: a commentary on the GREAT summit, *Disability and Rehabilitation: Assistive Technology*, 13:5, 492-496, DOI: [10.1080/17483107.2018.1472306](https://doi.org/10.1080/17483107.2018.1472306)

To link to this article: <https://doi.org/10.1080/17483107.2018.1472306>



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Published online: 17 May 2018.



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ORIGINAL RESEARCH



Systems thinking for assistive technology: a commentary on the GREAT summit

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ABSTRACT

The area of assistive technology has a long history of technological ingenuity and innovation. In order to ensure that the benefits of assistive technology are equitably distributed across the population and life course, it is necessary to adopt a systemic approach to the area. We describe examples of systems thinking and non-systems thinking across 10 Ps. These Ps are People (or users, as the primary beneficiaries of assistive technology), Policy, Products, Personnel, Provision (as key strategic drivers at systems level); and Procurement, Place, Pace, Promotion and Partnership (as key situational factors for systems). Together these Ps should constitute a framework for an “open” system that can evolve and adapt, that empowers users, inter-connects key components and locates these in the reality of differing contexts. The adoption of a stronger systems thinking perspective within the assistive technology field should allow for more equitable, more resilient and more sustainable assistive technology across high, middle- and low-income contexts and countries.

ARTICLE HISTORY

Received 27 April 2018
Accepted 30 April 2018

KEYWORDS

Assistive technology;
systems thinking;
sustainable development
goal; user involvement

► IMPLICATIONS FOR REHABILITATION

- The progress of assistive technology provision has been hampered by disconnected initiatives and activities and this needs to be corrected.
- Systems thinking is a way of thinking about the connections between things and how these are influenced by contextual and other factors.
- By encouraging the providers and users of assistive technology to think more systemically we can provide a more cohesive and resilient systems.
- The user experience is the central component of systems thinking in assistive technologies.

This commentary seeks to synthesize different aspects of systems thinking into an overall framework for assistive technology. As Co-chairpersons of the first Global Research, Innovation and Education on Assistive Technology (GREAT) Summit, which was organized under the auspices of the World Health Organization’s Global Collaboration on Assistive Technology (GATE) programme, our aim is to bring together several systems perspectives into a single coherent conceptualization. However, we do not suppose that this conceptualization will apply equally across different contexts, and we anticipate it may apply differently over time, even within the same context. We welcome commentary on it and the continued evolution of ideas within it. Ultimately our aim is to strengthen systems thinking within the realm of assistive technology. The ideas within this paper come from ourselves, but also from others who participated in the GREAT Summit, from people involved in systems thinking in other areas, and from some of those who have commented on papers prepared for the *GREAT Special Issue* of this journal [1].

An *assistive product* is “any product (including devices, equipment, instruments and software), either specially designed and produced or generally available, whose primary purpose is to maintain or improve an individual’s functioning and independence and thereby promote their wellbeing” [2]. The term “assistive technology” is often used as a generic term and that is how we

will also use it here. An *assistive technology system* refers to “the development and application of organized knowledge, skills, procedures and policies relevant to the provision, use and assessment of assistive products” [2]. This may therefore include the use of assistive technology and other infrastructure and technologies; such as information and communication technologies (ICT) and the Internet of Things (IoT), that promote the effectiveness of assistive technology (e.g. controlling over the Internet a home’s temperature from a remote location).

What is a system?

There is no one simple definition of a system, rather it depends on the context in which it is being applied. For instance, the Merriam-Webster Dictionary [3] suggests a system may be “a regularly interacting or interdependent group of items forming a unified whole”, or “a group of body organs that together perform one or more vital functions”, or “a group of devices or artificial objects or an organization forming a network especially for distributing something or serving a common purpose” or “harmonious arrangement or pattern”. Indeed, the same dictionary also offers other definitions in addition to these.

One of the fundamental distinctions regarding systems is that between so-called “open” and “closed” systems. Closed systems

tend to operate autonomously, separately from their environment and are designed to be consistent – to produce the same outcomes. Open systems are embedded within their environment and are dependent upon it, are usually designed to be responsive to it, and not necessarily consistent – their outcomes or outputs, may need to evolve and change over time. Broadly speaking, while closed systems are more characteristic of hardware engineering perspectives, open systems are more characteristic of social science, service sector perspectives that operate in greatly varied environments. While closed systems will be a critical component of the reliable functioning of particular assistive products, open systems are more characteristic of the broader environment in which assistive technology is developed, used, and innovated. In this paper we are therefore focusing on the latter – open systems – as this is consistent with the approach taken by others in similarly complex cogent areas ([4,5]).

What is systems thinking?

Systems thinking has several distinct characteristics [6]. These include “Forest Thinking”, referring to the value of distinguishing the wider “wooded area” from the individual trees; and of addressing the relationships between the trees. Another characteristic is “Dynamic Thinking” regarding how behaviours are arranged in patterns that may also change over time, or be different in different contexts. “Loop Thinking” which acknowledges that cause and effect are not one-off events but may be bi-directionally related to each other, in a continuous loop, is another characteristic. Perhaps one of the hallmarks of this approach is “System-as-Cause-Thinking”, where changes to one aspect of a system can have identifiable effects on other aspects of the system. For instance, changing how some elements of a system relate to each other, or introducing new elements, may reconstitute and affect outcomes in other aspects of the system that are not in direct contact with these changed elements. These sorts of characteristics of a system are challenging for disciplinary approaches more concerned with simplifying, controlling and reducing the explanatory level [7].

Systems thinking may also cut across disciplinary boundaries. Conceptualising the system as a Gestalt and identifying where the gaps or blockages are; is another way of systems thinking. However, to the extent that such a perspective sees a system as a whole, and also “open”, this means it can be influenced by outside factors too. These may include, for instance, economic booms and busts, supply and demand, policy and regulatory changes, by emigration and immigration; fear and protectionism; taxation, trade unions and market opportunism. While it should be acknowledged that recognition of such complexity may at times seem overwhelming, it can also be empowering. Systems thinking can facilitate interventions at different points, or at different levels in the causal network, that each contribute to the same over-all goal. For instance, removing professional protectionism regarding specific work practices, may allow people in rural areas to then develop different modes of delivery – perhaps employing health-care staff with shorter training and more focused skill-sets, or using specific technologies not previously used, or engaging community volunteers - to deliver interventions previously unavailable to rural dweller in poorly resourced areas (Gilmore et al. 2016).

Figure 1 is a schematic representation of how different aspects of assistive technology systems can be visualized; although their relative importance is likely to differ across different situations. The users of assistive technology – People – are at the centre. The four main strategic drivers originally identified by GATE – Policy, Products, Provision and Personnel – are the inner circle

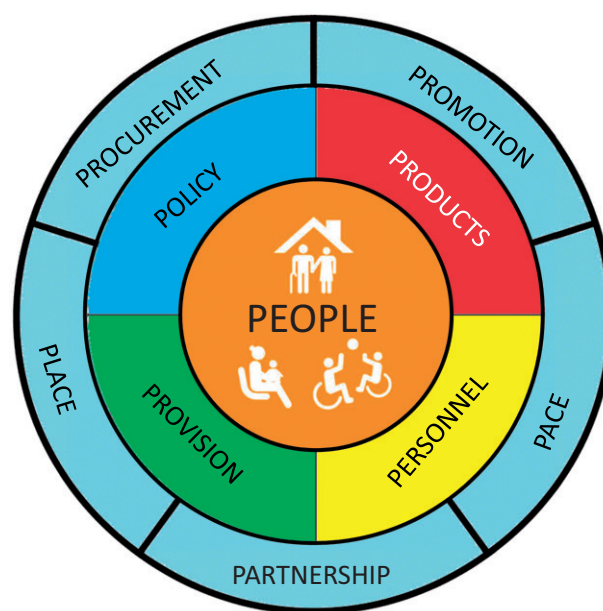


Figure 1. The 10Ps for systems thinking in assistive technology.

surrounding the users. The five contextual elements identified through the GREAT Summit and subsequent commentary – Procurement, Promotion, Place, Pace and Partnership – constitute the outer circle [8,9].

We now provide examples of non-systems thinking, followed by examples of systems thinking, for each of these 10Ps. It will be apparent that some themes recur across several elements; this in itself is an important feature of the interlinking and interlocking of systems.

People

Non-systems thinking is evident where AT Users attend multiple professions and multiple locations. Users are often seen as grateful recipients and may be expected to adopt the passive “patient role”. They may be categorized rather than individualized. They may also be reluctant to discuss service dissatisfaction, or assistive technology abandonment, in case of retribution or appearing ungrateful.

With systems-thinking, people (AT users) are seen as individuals, with a lifelong unique personal experience (e.g., [1,10,11]) that may differ in different sectors (health, education, employment, social connectedness, etc.). Identifying the appropriate technologies to support the person in overcoming these barriers is the primary goal. This involves keeping them active and central in the process, listening to them and where possible, supporting them. The AT user is the driver of the assistive technology process: including assessment, design, provision, training, delivery, monitoring and evaluation and policy-making. Taking into account their condition, needs, the context of use, preferences and where possible providing them choice. People are therefore seen as being highly differentiated, not only by type of impairment, origin (e.g., disability, frailty, chronic disease), but many other factors too. There is awareness of the importance of support networks, the influence of gender and of intersectionality more generally ([12]).

Policy

In non-systems thinking assistive technology policy, where it exists, is in subsections of different policies. There is little or no

coherent overall national vision for assistive technology and may be little or no rational resource-allocation (budgeting). The needs of some groups may also be addressed above those of others.

With systems-thinking, provision of assistive technology is seen as part of a wider policy effort to increase the well-being of the population. There is an overarching National Assistive Technology Policy (by whatever name), which articulates with other policies across different sectors; considers demand and supply; highlights resource implications and funding requirements and presents an integrated population-level approach, based on widely accepted and realistic principles of equity [13]. Policy may also make reference to improvements of productivity at the population level if assistive technology is provided (both for the individual and for carers who need to provide less time and effort in caring). The economic argument adds to the justification for the policy and acknowledges the openness of the systems with assistive technology opening up society and opening out productivity for users, into society. Furthermore, policy embraces a lifelong approach, whereby users' needs – as they transition across life stages – are met in a seamless (and more cost-effective) manner ([14]).

Products

In non-systems thinking, industry-led development of products focuses disproportionately on resource-rich areas. Alternatively, product development may be strongly influenced by civil society advocacy or interests or particular subgroups. Product standards are “absolute” and reflect the interests of specific group, such as manufacturers.

With systems thinking consideration of products is multifaceted, including recognition of which products are needed, production costs of products, supply and sufficient demand data aligning with product development and innovation. There are a range of different design-to-market pathways. Product standards reflect the needs of a range of stakeholders – especially users – and are more “relative” to the reality of their context and needs ([15], this volume).

Personnel

In non-systems thinking highly specialised professionals, who are protective of their demarcated silos, provide assistive products specific to their own narrow professional domain. Different professions therefore look only at specific aspects of assistive products and do not necessarily appreciate the whole picture of the range of products a user may be employing. As such, personnel may fail to develop a truly user-centred approach.

With systems-thinking the practical realities of the limited number of professionals is planned for through alternative models of service delivery, such as task-shifting in skill-mix systems, remote support for community-based providers, peer support networks and user expertise. Capacity building addresses a range of stakeholders – professional or otherwise – within the system and recognizes the expertise that users, potential users and their own circles of support – especially families – bring to assistive technology provisioning (see [16], this volume).

Provision

In non-systems thinking, provision of products may only be sanctioned by a small range of professionals with lengthy formal training and who are usually in limited supply and expensive to employ. These professions may also often work separately from each other. They may also work at central service points, where

distance and other access barriers are created for many assistive technology users.

With systems thinking multiple types of products may be provided at a one-stop, community-level location, with referral to specialist centres for users with more complex needs. Provision reflects individual and broader community needs. Flexibility in the system allows the potential for users to self-fund, or to generate the construction of bespoke solutions, depending on their complexity of need and availability of local support. Specialist centres provide services that reach into the community, including through flexible teleservices or other technology-mediated interactions ([17], this volume)

Procurement

Procurement is about purchasing, and at national level, this means securing the purchase of assistive technology to the scale required to meet the needs of the population; whether these products are sources in-country or imported. In non-systems thinking, large-scale procurement of assistive products may be based on broad population estimates of the incidence of different types of impairment. Procurement may also reflect the needs of vocal minority advocacy efforts; by those more able to make their voice heard. Assistive technology innovation may be overly supplier-led, based on supplier interests and opportunities, including pricing. Furthermore, technical standards may strongly reflect the interests of certain powerful industry or professional stakeholders.

With systems thinking, detailed data, such as from national census or national impairment surveys, give specific information on the incidence of different types of impairment in different areas of the country and different population groups. The concern for individually tailored services is balanced with the need to be able to scale supply to meet needs on a national level. Standards reflect the reality and resources of the markets being sold into. Different platforms (including on-line) allow users direct access for procurement. There is a nationally coordinated effort towards market shaping to ensure reliable, affordable and quality products are available in a timely fashion to those who need them [8].

Place

Place refers to the physical setting, but also the societal infrastructure within it – of government, policies, institutions – the psychosocial, sociopolitical and cultural context. In non-systems thinking, the focus is on the need to provide assistive products to people, for instance, people with disabilities; prioritizing short-term solutions, related to volume of product, cost per unit, or personnel required. It focuses on the product rather than the process and the reality of the available resources and supporting (or non-supporting) infrastructure available. There is little consideration of changing circumstances, for example, to the economy, conflict or natural disasters. The system is based on “firefighting” the current – often crisis – situation. There is little consideration of building resilience into the system.

With systems thinking, the focus is on the entire context, its resources and challenges; including, for instance, the value placed on the people – the users of assistive products. The interconnection between the socio-cultural, economic environment and political situation, past, present and future, to build sustainable infrastructures is paramount [18]. Physical environments and social spaces are designed for universal access that takes into account the needs for access for all.

Pace

While pace and place are closely connected they are not synonymous [19]. Pace is more focused on the *rate* of overall systems change that can be affected, while place is concerned with the *locale* in which it will happen. For lower-income countries, the dominance of aid donors may for instance have a much stronger influence on the pace of change, than does the place in which the change is required [20]. In non-systems thinking, the rate of change is seen as determined by “supply chain” factors, in a rather linear manner; assuming more or fewer existing resources, but essentially configured in the same way. This approach may result in inertia in the rate of systems change.

With systems thinking the readiness for change – its facilitators and barriers – in the broader policy context may not only be understood but a theory of change approach adopted to address these. This may involve setting realistic goals; starting from where the existing system is at and charting a realistic course for progress, taking into account competing interest and demands among stakeholders. In other policy contexts, this may be referred to as “timing” [21]. This may be influenced by the strength of advocacy or political will; by being open to trying to achieve the same ends by radically different means; by consideration of multiple entry points into the system; or by redefining overall goals and/or ways of achieving them. The speed with which international or national policy can be implemented will therefore be influenced by the agility of systems thinking, as well as a number of resource factors.

Promotion

In non-systems thinking particular products, services or outcomes are promoted without reference to the broader infrastructure required to make assistive technology successful. Assistive technology is presented as a single solution to a single problem. Its role in only one sector is highlighted. There is insufficient effort made to counter broader negative societal attitudes, structures or institutions that can continue to stigmatize AT users.

With systems thinking a positive image of assistive technology – in general – is promoted. The need to address stigma associated with disability, impairment and/or assistive technology is recognized, and there are clear efforts – through conventional and social media outlets – to promote a positive image of assistive technology use, and how this use depends on inter-related aspects of the assistive technology system and the interaction of it with broader society and social structures. The use of assistive technology as requiring coherence along the supply chain, across sectors and also for personal enhancement (habilitation – not just “deficit fixing”) is publically and effectively advocated.

Partnership

In non-systems thinking, collaborations are often opportunistic, reactive or short term; or between entities that operate in a similar sphere (production, or research, or policy), rather than across these. Provision may be through international civil society organizations that have few links with government, or local universities or local civil society. Partners may only operate at similar levels of the supply chain, not embracing up-stream or down-stream aspects, and therefore ignoring some of the potentially weaker linkages in the supply chain. Government may not incorporate civil society services in its national planning. Aid donors may not engage with government or other existing infrastructure that exists in the country.

With systems thinking, collaborations stretch across the major components of the systems in which partners are operating – while recognizing that the different partners have distinct strengths. Relationships are developed proactively and strategically to take into account supply-chain challenges. Collaborations embrace the importance of contributing to overall systems strengthening; and recognize the special role that government has to play in this regard. Partnership has a strong input from assistive technology users, whose contribution is clear at all levels of the collaboration. Partnership oversees and coordinates the interplay between the work of government, users, civil society, producers, service providers, donors and where appropriate, United Nations agencies. The effectiveness of partnership is continuously and transparently monitored and evaluated, and is considerate of local resources and values [22].

Conclusion

It will be clear from the above examples that while we have presented non-systems thinking and systems-thinking as two alternatives, often in reality they represent different ends of a continuum. Our aim is simply to make people more aware of what some of the characteristics of systems thinking may look like and encourage them to move further along the continuum towards a more systems thinking approach. It is important to recognize that the achievement of different goals may require different degrees of strength across different Ps [23], and thus, some systems are likely to be more capable of producing particular outcomes over others. Sterman [24] suggests that it is not a lack of resources, technical knowledge or commitment that prevents us improving things but “What thwarts us is our lack of meaningful systems thinking capability” (p.513). However, we are also aware that systems thinking is not everything. As already noted, embracing the complexity and inter-relatedness of a problem may make it seem insurmountable; and so smaller incremental wins may be targeted over more fundamental systems change [25]. As systems approaches embrace ecological models, the social determinants of health and well-being, and complexity theory, it is usually difficult to have controlled, matched or randomized interventions that produce easily comparable results [26]. Nonetheless, we contend that without understanding and acting through the interconnections that pattern complex systems – such as those characteristic of assistive technology systems – our impacts will be necessarily partial, restricted and often marginalizing. A systems thinking approach allows for a meaningful linking of components and processes, a more realistic understanding of why and where initiatives might fail or succeed, and a more satisfying way of placing the user of assistive technology at the centre of ideas, activities and outcomes. If assistive technology is to impact the achievement of the Sustainable Development Goal, as it has the potential to do [27], then systems thinking on a global level will be required.

Acknowledgements

We are particularly grateful to Jessica Power, Rosie Gowran, Evert-Jan Hoogerwerf and Johan Borg for their suggestions on aspects of this paper.

Disclosure statement

No potential conflict of interest was reported by the authors.

References

- [1] Scherer MJ, MacLachlan M. The GREAT Summit. Special Issue of the Journal Disability & Rehabilitation: Assistive Technology. 2018.
- [2] Khasnabis C, Mirza Z, MacLachlan M. Opening the GATE to inclusion for people with disabilities. *Lancet*. 2015;386:2229–2230.
- [3] Merriam, Webster. Merriam Webster Dictionary. 2018 [cited 2018]. Available from: <https://www.merriam-webster.com/>
- [4] Antonacopoulou E, Chiva R. Social complex evolving systems: implications for organizational learning. Boston: OKLC Conference; 2005.
- [5] Bailie R, Matthews V, Brands J, et al. A systems-based partnership learning model for strengthening primary healthcare. *Implementation Sci*. 2013;8:143.
- [6] De Savigny D, Adam T. Systems thinking for health systems strengthening. Geneva: World Health Organization; 2009.
- [7] MacLachlan M, McAuliffe E. Global Health Systems: micro, meso and macro psychology perspectives. In Selected Proceedings of the 20th Psychology Days in Zadar Conference. Zadar: University of Zadar. 2017. p 13–2
- [8] MacLachlan M. Assistive technology: systems thinking and market shaping. Paper presented at the WHO GATE Forum on Assistive Technologies. Zero Conference; 21–23 February; Vienna 2018.
- [9] MacLachlan M. Access to assistive technology, systems thinking, and market shaping: a response to Durocher et al. *Ethics Behavior*. 2018.
- [10] Scherer MJ. Connecting to learn: educational and assistive technology for people with disabilities. Washington, USA: American Psychological Association; 2004.
- [11] Scherer MJ. Living in the state of stuck: how assistive technology impacts the lives of people with disabilities. Massachusetts, USA: Brookline Books; 2005.
- [12] Desmond D, Layton N, Bentley J, et al. Assistive technology and people: a position paper from the First Global Research, Innovation, and Education on Assistive Technology (GREAT) Summit. *Disability & Rehabilitation: Assistive Technology*. 2018.
- [13] Amin M, MacLachlan M, Mannan H, et al. EquiFrame: a framework for analysis of the inclusion of human rights and vulnerable groups in health policies. *Ajod*. 2011;13:1–20.
- [14] MacLachlan M, Banes D, Bell D, et al. Assistive technology policy: a position paper from the First Global Research, Innovation, and Education on Assistive Technology (GREAT) Summit. *Disability & Rehabilitation: Assistive Technology*. 2018.
- [15] Smith RO, Scherer MJ, Cooper R, et al. Assistive technology products: a position paper arising from the GREAT Summit. *Disability & Rehabilitation: Assistive Technology*. 2018.
- [16] Smith E, Gowran R, Mannan H, et al. Enabling appropriate skills-mix towards progressive realisation of equitable access to assistive technology. *Disability & Rehabilitation: Assistive Technology*. 2018.
- [17] de Witte L, Steel E, Gupta S, et al. Assistive technology provision: a position Paper arising from the GREAT Summit. *Disability & Rehabilitation: Assistive Technology*. 2018.
- [18] Poole A. Political economy assessments at sector and project levels: How-To notes. Washington (DC): World Bank; 2011.
- [19] Gowran RJ, Kennan A, Marshall S, et al. Adopting a sustainable community of practice model when developing a service to support patients with epidermolysis bullosa (EB): a stakeholder-centered approach. *Patient*. 2015;8:51–63.
- [20] MacLachlan M, Carr SC, McAuliffe E, et al. The Aid Triangle: recognising the human dynamics of dominance, justice and identity. *J Pac Rim Psychol*. 2011;5:51–52.
- [21] Pralle SB. Timing and sequence in agenda-setting and policy change: a comparative study of lawn care pesticide politics in Canada and the US. *J Eur Public Policy*. 2006;13:987–1005.
- [22] Mji G, Gcaza S, Swartz L, et al. An African way of networking around disability. *Disabil Soc*. 2011;26:365–368.
- [23] Scherer MJ, Borg J. Referral, intake and initial assessment. In: Shay A, editor. *Assistive technology service delivery: a practical guide for disability and employment professionals*. Massachusetts, USA: Academic Press; 2018.
- [24] Sterman JD. Learning from evidence in a complex world. *Am J Public Health*. 2006;96:505–514.
- [25] MacLachlan M. From sustainable change to incremental improvement: the psychology of. *Psychol Develop World*. 1996;26.
- [26] Trochim WM, Cabrera DA, Milstein B, et al. Practical challenges of systems thinking and modeling in public health. *Am J Public Health*. 2006;96:538–546.
- [27] Tebbutt E, Brodmann R, Borg J, et al. Assistive products and the sustainable development goals (SDGs). *Global Health*. 2016;12:79.