Digitally Networked Social Services: Mapping the National Disability Insurance Scheme (NDIS) online network in Queensland, Australia

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Abstract

Within growing marketisation of publicly funded services, the internet has provided new
opportunities for marketing, delivery, and coordination of those services. Using web scraping
and hyperlink network analysis techniques, this paper examines the ways in which organisa-
tions operating in Australia's evolving National Disability Insurance Scheme (NDIS) system
inter-connect online. Social media plays the most important role in the online network.
Government agencies also play a central role, with many disability service organisations link-
ing their web users to them. Government agency websites do not hyperlink to disability service
providers, suggesting that governments do not see their role as assisting access to such services.
Advocacy and peak disability organisations are important in online connections between the
websites of government and service organisations. Innovative uses of the internet for online
brokerage of disability services are evident. The implications of these findings for service deliv-
ery are discussed.

Introduction

Over the last two decades, there has been a fundamental repositioning of the
design, delivery, and consumption of publicly funded services. This reposition-
ing has occurred via two major trajectories. The first involves New Public
Management (NPM) that aims to transform public services using corporate
managerial practices. The second involves the use of internet technologies for
service delivery. This paper investigates the provision of disability services to

Australians via the National Disability Insurance Scheme (NDIS) located within these two trajectories. It traces the web footprint of NDIS's quasi-marketised service network, giving visibility to the ways in which social policy and publicly funded services are positioned within online networks. These positions affect how people experience a social service system intended to benefit them.

Since the 1980s governments have increasingly adopted neo-liberal and corporate managerial inspired models of public administration and service delivery. As well as managerialism, contractualism, and marketisation, NPM also involves a focus on service quality, efficiency, and performance outcomes (Pollitt, 2003: 27-8). Outsourcing and quasi-marketisation have occurred in health care (Krachler et al., 2021), employment services (Considine et al., 2011) and care services (Knapp et al., 2001). While driven by objectives of efficiency and effectiveness, such changes also reframe services as personalised to individual needs (Christensen and Pilling, 2014; Power, 2014; Toerien et al., 2013) and service users as choice-making customers (Clarke et al., 2007). Choice is an important political and policy objective that gives people autonomy and recognises their rights, as well as providing a form of organisational accountability and competitive drive to improve services (Greener, 2008). However, consumers must have the information to confidently and accurately make informed choices; which relies on knowing organisations, their services, relative prices and service qualities.

The second, digital, trajectory has also profoundly affected how publicly funded services are delivered and how service users experience them. From traditional public services via paper forms and face-to-face interactions with administrators in physical offices, digital government has enabled contact via telephone call centres, websites, smart phone apps, and even chatbots (Henman, 2022). Automation has advanced personalised services (Considine et al., 2022). Digital technologies enhance outsourcing through digital data reporting mechanisms to ensure centralised governance of de-centralised service providers leading some to suggest digital government and NPM are intertwined (Homburg, 2004).

Delivering publicly funded services digitally generates concerns about digital exclusion (Park and Humphry, 2019), and increased surveillance (Graham and Wood, 2003). Conversely, digital technologies can empower citizen-consumers to actively seek out government information and services, exercise their review and appeal rights, and select the services they prefer. Websites providing policy and service information can enhance citizen-consumers' choice within a quasi-market by helping to identify and assess service providers, use online broker services, and compare organisational performance (Martin and Carter, 2017).

The implications of the intersection of digital technology and public services for people with disability are complex. Digital technologies have sometimes

benefited people with disability to navigate government and public services (Blackburn and Read, 2005; García-Crespo *et al.*, 2012; Mavrou *et al.,* 2017), including enhancing mobility (Sartori do Amaral *et al.*, 2019), and through inclusive and personalised design (Liaaen *et al.,* 2021). Digital technologies also provide new avenues for care and treatment for people with disability (Sheehan and Hassiotis, 2017). While there remains a digital divide between people with disability and the rest of the population (Johansson *et al.,* 2021), people with disability also use the internet to seek health and service information, obtain professional and peer support, and ensure advocacy (Glencross *et al.*, 2021; Ramsten *et al.*, 2020). Digital platforms have also been the space for new service delivery designs, such as a 'Tripadvisor' for disability (McLoughlin *et al.*, 2019). Yet, digital services designed to enhance autonomy and choice can end up constraining and surveilling (Mateescu, 2021).

Websites therefore become a key locus point in the confluence of these two trajectories. They provide a means by which government agencies and organisations operating in a quasi-market of publicly funded services can inform citizen-consumers about government funding and service delivery options, and to market their offerings. Websites also enable citizen-consumers to ascertain their eligibility, access and options for services, and are able to make choices and exercise consumer agency (Margetts and Dunleavy, 2002). Additional to applying for government funded services, consumers can select and engage with service providers, read and write customer reviews, co-create services, and enact appeal and review rights (Chun *et al.,* 2010). Websites are also the means through which organisations can help direct website users to other information, resources and organisations, and signal inter-agency connections. Accordingly, examining the 'web ecology' of websites within a quasi-market highlights how quasi-markets operate, charts their composition, and provides insight into the ways in which citizen-consumers experience contemporary government and publicly funded service delivery.

Through the application of innovative research tools, this paper seeks to provide insights into some contemporary arrangements in social policy and service delivery. It does so through an examination of Australia's recently established NDIS. The NDIS is posited on both a social insurance model with universal access and a marketised delivery mechanism to provide choice and control to Australian citizens with disability eligible for personal supports funded under the NDIS (identified as NDIS participants) (Purcal *et al.*, 2016). This study focuses on the way in which organisations within this marketised network inter-connect online – for example, between health and disability sector interfaces, between mainstream and disability specific services, and between siloed services that together could provide holistic care and support. Methodologically, the paper does this by examining the online hyperlink networks of websites of organisations involved in the NDIS, which indicates

information and service flows between organisations that NDIS participants might seek or be expected to navigate in the online world. This hyperlink analysis also highlights new modes of organising and operating social services that arise from the evolving NDIS market.

We used digital research tools to understand, visualise and map the online structure and hyperlink relationships between policy, disability, health and community organisations providing supports to NDIS participants. This digital research was important for two reasons. Firstly, the results are the first attempt to map and visualise the large-scale structure of the NDIS-related online network. Secondly, hyperlink network analysis can potentially highlight organisational governance structures and inter-organisational connections that might be present offline. This methodology of approaching online inter-organisational networks at a system level, complements bottom-up studies studying networks of NDIS inter-organisational collaboration and professional information sharing (Foster *et al.*, 2021; Malbon *et al.*, 2019). Thus, this methodology provides a new and complementary way to examine contemporary service delivery in an online world.

This paper addresses two key questions:

What are the key characteristics of the network of NDIS-related organisations' websites?

What are the varied roles that websites of different types of service providers play in the online presence of the NDIS system?

Australia's NDIS and Network Challenges

Australia's NDIS is a national approach to support for people with significant and complex needs. Administered by the National Disability Insurance Agency (NDIA) under the *National Disability Insurance Scheme Act* 2013, the NDIS shifts from the previous system of targeted disability support to a universal insurance-based approach (Purcal *et al.*, 2016) providing non-means tested services to all Australians if they join the Scheme before 65 years of age (Walsh and Johnson, 2013). Participant choice and control are central to how NDIS supports are planned and implemented, thus creating the conditions for a changing mix of state and non-state actors to deliver support. Unlike the previous block-funding approach where organisations were funded directly to provide services (Laragy *et al.*, 2015; Purcal *et al.*, 2014), NDIS participants become service purchasers (not just consumers) and therefore need clear information to exercise choice and control in relation to funded supports (David and West, 2017). This is challenging given the NDIS has stimulated a rapidly

changing organisational environment (Carey *et al.*, 2018), which comprises multiple complex market systems (Reeders *et al.*, 2019).

The internet provides opportunities for increased access to information and services by people with disability and connecting across service interfaces. In 2018, 72% of Australians with disability aged 15 or over had accessed the internet in the past 3-months (Australian Bureau of Statistics, 2020). Relevance of the online environment also holds true for NDIS participants, where increasing portions of service delivery and information about the NDIS and participant rights occur online, facilitating active self-management and empowerment. Online conduct by people using the services is consistent with both neoliberal and rights-based approaches to create active, empowered and self-managing citizen-consumers (Clarke *et al.,* 2007). A key feature of the NDIS is personalised budgets and plans, which participants can access via an online portal, myplace, to view and manage funding, bookings and payments[1].

The web is also increasingly important for organisations to bolster their online presence as a means of facilitating information sharing, communication, and collaboration, as well as marketing their products and services to NDIS participants. Understanding how government, non-government and commercial agencies are interconnected online can provide insights into the emergent structure and significant relationships in the new disability support system. In turn, this may help stimulate discussion and questions regarding online and offline inter-organisational collaboration among NDIS-registered providers, mainstream services and other organisations.

Conceptualising the NDIS System as an Online Network

Recent work by Henman and colleagues (2021) has conceptualised national government webportals as being located within three intersecting networks: an institutional ecology; an informational ecology; and a web ecology. The online network of the NDIS system can be conceptualised in a similar manner, providing a novel ontological approach to the NDIS.

Firstly, the NDIS system consists of a network of organisations. At the core is the NDIA – the agency responsible for governing and determining eligibility and funding for NDIS participants. The Australian Department of Social Services (DSS) is responsible for NDIS policy, while the NDIS Quality and Safeguards Commission (NDISQSC) manages registration and compliance of providers and responds to participants' complaints. Various State and Territory government agencies have responsibility for disability policy and services, yet most work is undertaken by a mix of disability specific and mainstream services (Purcal *et al.,* 2016). This vast quasi-market network constitutes an *institutional ecology* with varied inter-institutional relationships connected through contracts, financial flows, reporting requirements, and so on.

Systemic inter-relationships (or interfaces) between health and disability service organisations are framed by wider social policy settings.

Another major set of inter-institutional relationships are defined by financial flows from the NDIA to NDIS participants to NDIS service providers, while others flow directly from NDIA to NDIS service providers. Information flows between these organisations also occur, such as policy information from the government agencies to providers and users, and reporting relationships flowing in the opposite direction. There are also referral and collaborative information exchanges. In total, this vast information network constitutes an *information ecology* with varied subsystems involving different information types and flows.

Finally, the NDIS is located within a *web ecology* defined by the online websites and social media presence of each institution (cf. Henman and Graham, 2020). The web ecology includes websites owned and managed by NDIS-relevant organisations and service providers, including government and non-government organisations (NGOs), and commercial entities across a multitude of sectors from health and disability to housing, education, and transport. Each website is hyperlinked to other organisations that provides a means of linking web users to relevant content, thus creating a network structure that can be mapped. This network also includes social media accounts used by many government, NGO and commercial organisations. Websites and their hyperlinks are mechanisms to connect NDIS providers and participants; and to some extent indicate the presence (and absence) of important relationships. Accordingly, each website and social media account contains important information forming part of the information ecology. The online hyperlinks between organisational websites may reflect types of offline organisational relationships (e.g. formal contractual partnerships, information referral or information sharing relationships). Mapping and monitoring websites and hyperlinks are therefore important for understanding the organisational structure of the disability sector, the connectiveness between organisations, and the realities faced by NDIS participants in navigating the NDIS online network.

We argue that these three ecologies – institutional, information and web – variously overlap. Most NDIS-related organisations will have a web presence. Hyperlinks can reflect offline inter-organisational relationships, which may involve information flows. For example, a NDIS participant receiving services from two collaborating organisations may have discovered their collaborative relationship online traversing hyperlinks between them. For NDIS participants navigating the NDIS online, they are likely to obtain information about policy and services options via hyperlinked websites. Thus, the NDIS hyperlink system can be suggestive of institutional structural relationships and informational flows that web users traverse in engaging with the NDIS. Importantly, the hyperlink network is a structure (like a road map) and does not provide information about flows of NDIS participants, web users or so on through these links (similar to traffic volume). This requires other forms of data.

The use of hyperlink networks to investigate government, policy and service communities is rather niche. However, several authors have explored the ways in which hyperlink networks involving government are variously structured by offline characteristics, including geography, constitutional and institutional settings, and service/policy domains (Henman *et al.,* 2014; Henman *et al.,* 2021; Holmberg and Thelwall, 2008; Nicholls, 2016). This paper similarly uses hyperlink network analysis methodologies to suggest insights into offline phenomena.

Research Design, Methods and Analysis

The study aimed to map and analyse the online presence of organisations operating in the NDIS system and their online inter-organisational relationships. Website design involves strategic decisions about which websites or webpages to link to. Through outwards hyperlinks, an organisation indicates to people using their website other important organisations. The purpose of these links is varied, including conveying valuable information and expressing inter-organisational relationships (Nicholls, 2016:161).

In constructing a map of the web ecology of the NDIS system, first, for data size purposes we decided to focus at the state rather than the national level, specifically Queensland. Historically, Australian states and territories have varying approaches to the funding and organisation of disability services, including the extent of individual funding models (Purcal *et al.,* 2014). The NDIS was progressively implemented in Queensland from 2016 to 2020, making it one of the last states to implement the NDIS, and unlike other jurisdictions had very limited examples of individualised disability funding prior to the NDIS, which is emblematic of the NDIS (Purcal *et al.,* 2014). This enabled the possibility for a subsequent study to see how the market network had evolved over time.

Secondly, a sample of 216 organisational websites, including 22 purposively selected organisations were identified as seed websites for web crawling. Seven were prominent agencies in the disability, policy, and services sectors (e.g. state/national government, advocacy, and peak representative bodies[2]), and representing diverse types (e.g. non-government, not-for-profit, private-for-profit, and social enterprise). Additionally, 15 Health and Hospital Services (HHS) and 179 randomly selected websites were also included. The 179 random providers were sourced from the Queensland NDIS-registered provider list from 31 March 2019.[3] The list contained 4,547 NDIS registered providers, of which 2,733 had websites listed. Every 13th provider was selected, excluding those with duplicate websites (n=57), or those whose organisational website was a Facebook account (n=21) or inoperable websites. All 179 systematically randomly selected providers are NDIS-registered but not necessarily disability focused, with some organisations providing mainstream, but NDIS-approved services (e.g. housecleaning, construction, fitness, household maintenance).

To understand the type of organisations making up the seed sites, an analysis of the top-level generic domain (e.g..gov,.com,.edu) of their websites was undertaken (Table 1, column 3). This suggests that seed agencies are primarily commercial (.com, 75%), organisational[4] (.org, 12%) or government (.gov, 11%). Seed websites were also manually coded into five categories – commercial; government; non-government; peak bodies; and social enterprise – by reference to each website and expert knowledge from the researcher team. This coding found a similar pattern: predominantly commercial (69%), NGOs (17%) and government (11%) (Table 2, column 2).

From June to August 2019 all webpages of each of 216 websites were crawled for all internal and external hyperlinks using a purpose-built web crawler in the statistical package, R. The resulting hyperlink network of web*pages* was converted to a network between web*sites* through a process of grouping webpages with the same base URL. Consequently, the webcrawl identified: (1) hyperlinks between the 216 seed websites and (2) outgoing hyperlinks from the 216 seed websites to 8,421 other newly identified websites. The full network contains 8,637 nodes (websites) and 13,647 edges (hyperlinks). In network parlance, this is a weighted, directed network. As detailed below, this hyperlink network was analysed by classifying top-level generic domains (e.g..gov,.com,.org), using several social network metrics, and data visualisation using Gephi.

Relational hyperlink analysis involves analysing hyperlinks as networks, using statistical techniques from social network analysis (Borgatti *et al.,* 2018). One approach involves identifying the important nodes (websites) and their role in the network. For this purpose, we applied Kleinberg's (1999) Hyperlink-Induced Topic Search (HITS) algorithm, which produces an Authority and a Hub score (range 0.0-1.0) for each node (website). Sites identified with a high hub score are those pointing to numerous high authority sites. In effect, sites with a high hub score play an information brokerage or referral role. Authority scores are a measure of a website's value to others within the network, indicated by many other websites pointing to it.

Methodological decisions limited this research. Websites of all NDIS-registered organisations for Queensland were not crawled – however, a modest random sample of such websites were. The methods provide a map of hyperlinks between organisations' websites at a particular time (not changes over time). These inter-website links reflect how an organisation seeks to define its online inter-organisational relationships, which are not the same as formal inter-organisational relationships. Hyperlinks map routes, but do not indicate the traffic levels of web users traversing those hyperlinks. Regardless, the study makes a useful contribution to understanding the NDIS online network, that could be expanded in future research.

TABLE 1. Composition of the NDIS online networks by website type

Website type	Full network (n, %)	Seed websites (n, %)	Connected seed websites (n, %)	Isolated websites (n, %)
Top-level generic domain				
.com (commercial)	4163 (48.2%)	161 (74.5%)	58 (55.2%)	103 (92.8%)
.org (organisational)	2277 (26.4%)	25 (11.6%)	22 (21.0%)	3 (2.7%)
.gov (government)	1452 (16.8%)	24 (11.1%)	22 (21.0%)	2 (1.8%)
.edu (education)	321 (3.7%)	–	–	–
.net (net)	231 (2.7%)	3 (1.4%)	1 (1.0%)	2 (1.8%)
.asn (association)	68 (0.8%)	1 (0.5%)	1 (1.0%)	–
.info (information)	26 (0.3%)	1 (0.5%)	–	1 (0.9%)
.int (international)	8 (0.1%)	–	–	–
others	79 (0.9%)	1 (0.5%)	1 (1.0%)	–
Total	*8,637 (100%)*	*216 (100%)*	*105 (100%)*	*111 (100%)*
Website country code				
.au (Australia)	5969 (69.1%)	177 (81.9%)	89 (84.8%)	88 (79.3%)
.uk (UK)	103 (1.2%)	–	–	–
.ca (Canada)	33 (0.4%)	–	–	–
.nz (New Zealand)	25 (0.3%)	–	–	–
none/other	2507 (29.0%)	39 (18.1%)	16 (15.2%)	23 (20.7%)
Total	*8,637 (100%)*	*216 (100%)*	*105 (100%)*	*111 (100%)*

Note: commercial also includes.co; government also includes.gouv and.gob; education also includes.ac; others typically refer to websites in countries that often use non-generic domain names.

TABLE 2. Organisation type of seed network

Organisation type, n (%)	Seed network (n=216)	Isolated websites (n=111)
Private	150 (69.4)	96 (86.5)
Non-government organisation	37 (17.1)	12 (10.8)
Government	24 (11.1)	2 (1.8)
Peak	3 (1.4)	0 (-)
Social enterprise	2 (0.9)	1 (0.9)

Results

Findings are reported by firstly examining the full network of 8,637 websites, and secondly examining the relationships between the 216 seed websites which are directly related to the NDIS system. Thirdly, we explore the online role of specific organisations to reflect on the confluence or otherwise of their online and offline organisational practices.

The wider web ecology of the NDIS online network

The full online network derived from the neighbours of seed sites (sites that a seed site links to) consists of a wide range of organisational websites well beyond NDIS or disability-related organisations. It includes social media websites as well as a heterogenous collection of websites. This is perhaps not surprising given that there are mainstream commercial organisations among the seed sites in addition to disability and allied health service organisations. Understanding this wider network provides insights into the broader web ecology in which the organisations in the NDIS system are located.

Figure 1 visualises the hyperlink network obtained from the crawl. Table 1 (column 2) highlights that, of its 8,637 websites, almost half (4,163, 48%) are commercial (.com) websites. Organisational websites (.org) make up about a quarter of this network (2,277, 26%), whereas government (.gov) sites make up only 17% (1,452) of the websites and educational (.edu) websites make up 4%. Unsurprisingly, the websites are largely Australian (69%), with most of the others having no country code (29%), which typically is used for commercial sites, such as www.google.com. Other websites were in the UK (1%), Canada (0.4%) and New Zealand (0.3%). Many of the neighbouring websites are not interconnected with the main disability organisations or other seed organisational websites, suggesting that many seed sites are linked into other non-disability related web networks.

The HITS algorithm (explained above) identified the most important websites in the full NDIS hyperlink network. The top 20 authority and hub websites are shown in Table 3. Figure 2 visualises the interconnections between the top 100 websites by authority score.
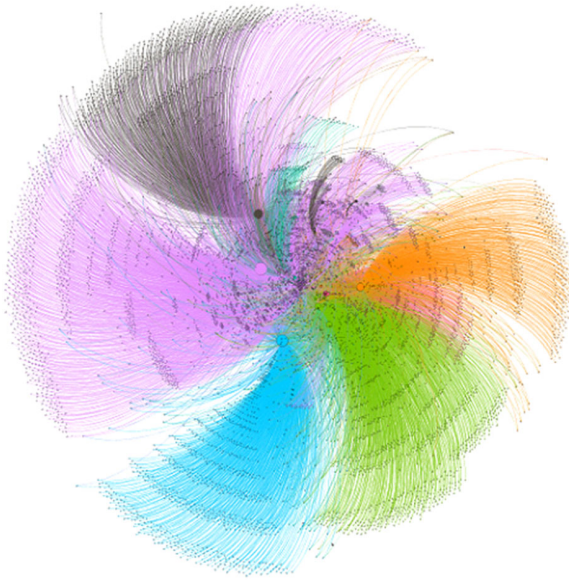
Figure 1. NDIS hyperlink network. Coloured by modularity
Note. Colours are based on network modules automated by the Gephi visualisation package and cannot be assumed to relate to specific websites or groups of website.

Social media platforms (Facebook #1, Twitter #2, YouTube #3, LinkedIn #4 and Instagram #5) accounted for the top five highest authority scores (Figure 2, Table 3). Such sites are generally deemed 'authoritative' due to the frequency with which government and organisational websites link to their social media accounts from homepages, and is an occurrence mirrored in the British and Australian government online networks (Henman *et al.*, 2014; Henman and Graham, 2020). Even though government websites account for only 17% of the network, government websites make up the next most authoritative websites in the wider NDIS online network (11 of the 20 top sites). Australian Federal government websites – NDIA (#6), Human Services (#7), Department of Health (#10), My Aged Care (#11) and National Health and Medical Research Council (NHMRC, #19) – typically have higher authority scores than those of state governments. Mental health services were also among the top 20 authority websites (Lifeline (#9); Beyond Blue (#10) and Headspace (#20)); as were regulatory agencies (Australian Health Practitioner Regulation Agency (AHPRA, #15); Australian Commission on Safety and Quality in Healthcare (#18)). The importance of government websites is also illustrated in Figure 2 (blue), as are organisational (.org) websites (green). Commercial (.com) websites providing online services were also present within the top 100 highest authority websites (authority scores: Google, 0.057; Survey Monkey, 0.059; iTunes, 0.057;

TABLE 3. Authority and hub scores for websites within the broader NDIS online network (n=8,637)

| Rank	Website	Authority	Website	Hub
1	facebook.com	0.138	sahealth.sa.gov.au	0.538
2	twitter.com	0.122	clickability.com.au	0.371
3	youtube.com	0.121	goldcoast.health.qld.gov.au	0.328
4	linkedin.com	0.115	metronorth.health.qld.gov.au	0.293
5	instagram.com	0.097	dss.gov.au	0.264
6	ndis.gov.au	0.086	childrens.health.qld.gov.au	0.260
7	humanservices.gov.au	0.086	metrosouth.health.qld.gov.au	0.235
8	qld.gov.au	0.079	health.qld.gov.au/sunshinecoast	0.134
9	lifeline.org.au	0.078	health.qld.gov.au/cairns_hinterland	0.120
10	health.gov.au	0.074	communities.qld.gov.au	0.118
11	myagedcare.gov.au	0.073	westmoreton.health.qld.gov.au	0.118
12	beyondblue.org.au	0.070	townsville.health.qld.gov.au	0.108
13	health.qld.gov.au	0.068	health.qld.gov.au/cq	0.095
14	health.qld.gov.au/clinical-practice	0.066	ndis.gov.au	0.093
15	aphra.gov.au	0.065	health.qld.gov.au/darlingdowns	0.083
16	raisingchildren.net.au	0.063	health.qld.gov.au/abios	0.078
17	health.qld.gov.au/public-health	0.062	scopeaust.org.au	0.076
18	safetyandquality.gov.au	0.061	qdn.org.au	0.069
19	nhmrc.gov.au	0.059	nds.org.au	0.066
20	headspace.org.au	0.059	spinal.com.au	0.066
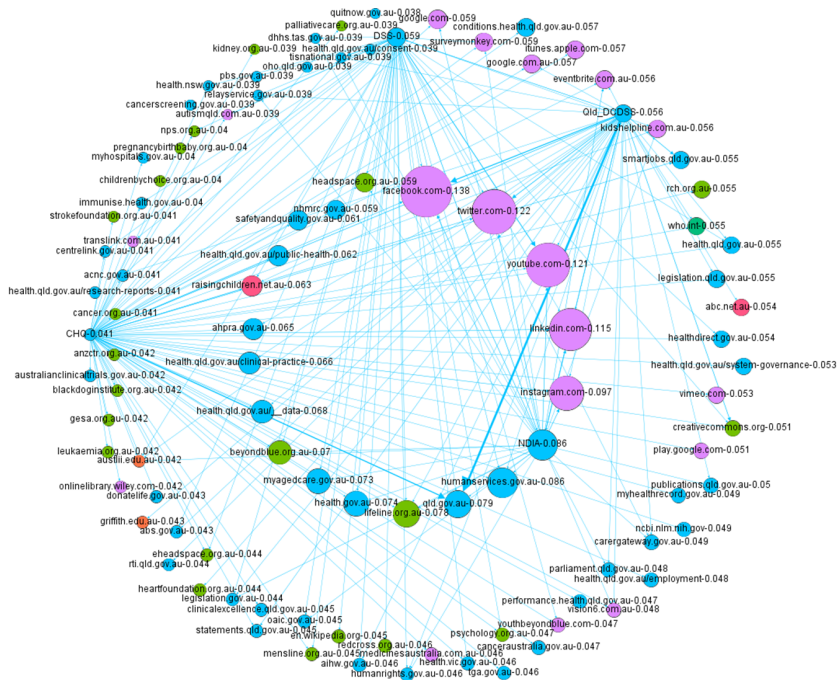
Figure 2. Top 100 authority scores from the full NDIA network
.com=purple;.gov=blue;.org=green;.edu=red;.net=pink
Note. The 20 nodes for the inner circle have the highest Authority compared to other websites, indicating their content is most valued within the full network.

EventBrite, 0.056). This finding reinforces not only the importance of commercial social media accounts in the delivery of publicly funded services, but also the importance of other commercial technology services.

Hub scores reflect the value of a website's outlinks for other websites within the network and as such can be imagined as information brokers, or referrer websites. Notably all top 20 hub websites are seed websites (Table 2). This is an outcome of our methodology, where we only crawled the outlinks of seed websites, and hubs are those with many outlinks. A more extensive webcrawl of the neighbours of seed sites would have provided more information but would risk not relating to the NDIS. While our methodology limits potential insights of the hub scores, it does highlight which websites are important to other seed websites. Notably, 11 of the top 20 hub websites (including #1) are government health websites. This partially results from them being large websites with large numbers of outlinks.[5] Clickability, an Australian disability service directory website, was among the top hub scores (#2), which is understandable given its purpose as an information broker and disability service matching provider. Clickability is an example of new organisations that have
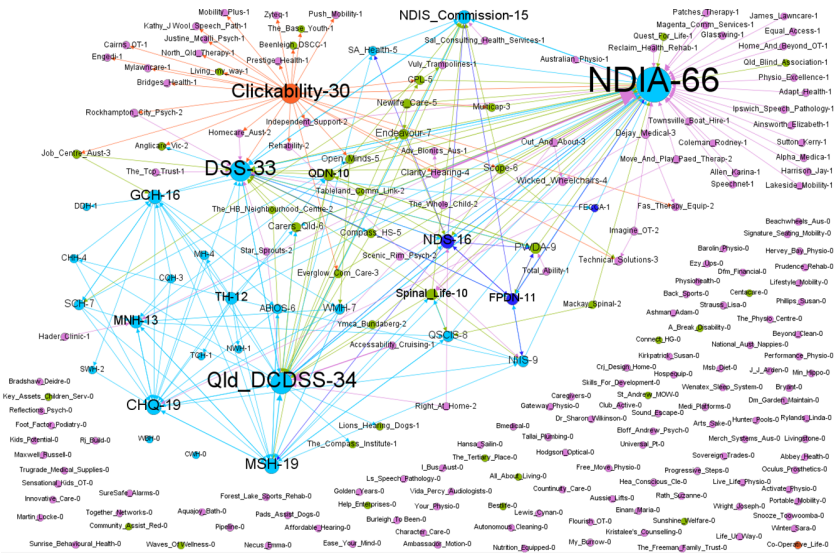
Figure 3. Hyperlink relationships between 216 seed websites

Note. Private organisations, purple; Non-government organisations, green; Government, light blue; Peak bodies, dark blue; and Social enterprise, orange.

arisen within the NDIS's quasi-market, whereby NDIS participants are positioned as consumers with choice to select their own service providers. Scope (#17) is an example of an older disability organisation with a similar role. It appears to have responded to online networking opportunities. Apart from government health websites, the key Australian NDIS policy and delivery agencies had high hub scores: the DSS (#5) and the NDIA (#14). Leading disability organisations in the top 20 included National Disability Services (NDS, #19) and Queenslanders with Disability Network (QDN, #18). Prominent disability-focused support organisations were also among websites with higher hub scores: Spinal Life (#20) and Acquired Brain Injury Outpatient Service (ABIOS, #16).

Web ecology of the seed websites

To obtain a better understanding of the structure and inter-connections of the NDIS online network, we focused on the relationships between the 216 seed websites, as visualised in Figure 3, with colours denoting organisational type as hand coded by the researchers. A key finding was that half (51%, 111) of seed websites were not connected to any of the other 215 seed sites by either outgoing or incoming hyperlinks. These isolated sites were largely commercial organisations (87%) (Table 2) representing allied health and other mainstream types of services (e.g. audiology, psychology, plumbing). Based on reviewing their websites, many of these are small businesses, which although NDIA registered, lack

TABLE 4. Authority and hub scores for websites within the connected seed network (n = 105 websites)

Rank	Website	Authority	Website	Hub
1	ndis.gov.au	0.743	townsville.health.qld.gov.au	0.219
2	communities.qld.gov.au	0.379	nds.org.au	0.217
3	dss.gov.au	0.358	goldcoast.health.qld.gov.au	0.210
4	ndiscommission.gov.au	0.198	qdn.org.au	0.201
5	metrosouth.health.qld.gov.au	0.161	spinal.com.au	0.194
6	childrens.health.qld.gov.au	0.152	endeavour.com.au	0.193
7	nds.org.au	0.135	clickability.com.au	0.185
8	pwd.org.au	0.083	communities.qld.gov.au	0.183
9	niis.qld.gov.au	0.082	dss.gov.au	0.180
10	fpdn.org.au	0.080	compasshousing.org	0.178
11	health.qld.gov.au/abios	0.074	metrosouth.health.qld.gov.au	0.171
12	metronorth.health.qld.gov.au	0.066	fpdn.org.au	0.170
13	health.qld.gov.au/qscis	0.065	metronorth.health.qld.gov.au	0.164
14	carersqld.com.au	0.056	westmoreton.health.qld.gov.au	0.160
15	spinal.com.au	0.048	ndiscommission.gov.au	0.157
16	goldcoast.health.qld.gov.au	0.047	carersqld.com.au	0.157
17	tecsol.com.au	0.045	scopeaust.org.au	0.157
18	qdn.org.au	0.044	sahealth.sa.gov.au	0.138
19	sahealth.sa.gov.au	0.043	newlifecare.nu	0.130
20	anglicarevic.org.au	0.039	pwd.org.au	0.130

online connectivity to the NDIA website, either by hyperlinking their clients to the NDIS/NDIA or being pointed to by the NDIA. Nor is there any connectivity with other major disability organisations. This suggests that these 111 NDIA-registered organisations do not position themselves or their clients within disability services, nor are they seen by disability organisations as key parts of the NDIS (online) network. This can be interpreted as an outcome of the quasi-marketised nature of disability services that the NDIS stimulated, with mainstream organisations positioning themselves as providing NDIS services. Given the lack of connection to the main NDIS online network, it suggests they have only rudimentary or nominal involvement to the NDIS service system. Accordingly, the remainder of the analysis of the web ecology focuses only on the 105 interconnected seed sites.

Important websites in the seed website hyperlink network were identified using the HITS algorithm (Table 4). Interestingly, 13 websites were among both the top 20 authority and top 20 hub scores, suggesting that they were important in the NDIS network for both acting as a repository of important information and directing users widely across this network. As expected, this included the three major Australian government agencies responsible for the NDIS (NDIA, DSS, NDISQSC) and the Queensland state government agency responsible for the NDIS (then Department of Communities, Disability Services and

Seniors). Five advocacy groups (Carers Queensland, People with Disability Australia (PWDA), First Peoples Disability Network Australia (FPDN), QDN, Spinal Life) and four local HHS districts were also included in this group of 13. The inclusion of the HHS is perhaps an artefact of our method and reflects the strong intersections between HHS. However, the high presence of websites of advocacy organisations is reassuring.

Other notable websites with high authority scores include the Queensland government's National Injury Insurance Scheme Queensland (NIISQ), two state-wide health services (ABIOS and Queensland Spinal Cord Injury Service) and the peak service provider organisation (NDS). Among notable websites with high hub scores, those acting as connector organisations, are three disability service provider organisations (Endeavour, Compass Housing, Scope), and Clickability, a disability service directory website.

Specific organisations and their websites

Finally, we focused on several prominent websites to provide more detailed understanding of the nature of their inter-connections with other websites within the full NDIS network. This analysis helps to understand two key considerations in inter-organisational relationships. Firstly, the outgoing hyperlinks tell us which websites are viewed by that organisation as important for people using their website to navigate to. Secondly, the incoming hyperlinks identify what other organisations think is important to link to this website.

From the 105 interconnected websites, we chose NDIA, NDS, PWDA and Clickability to examine in more detail. These were selected due to their organisations' key defining role in the sector as respectively the government's NDIS agency, the national disability service provider peak body, a national disability advocacy organisation, and a new innovative NDIS organisation, and due to their high authoritative or hub websites (Tables 3 and 4).

National Disability Insurance Agency (ndis.gov.au)

As the government agency implementing the NDIS, we anticipated that the NDIA website would have numerous webpages and link users to NDIS-registered organisations in general, and key disability peak, advocacy and consumer support organisations, while also being a key website to which NDIS-registered organisations would point. We discovered that the NDIA website is indeed large, with 3,492 webpages, and was pointed to from 66 of the 215 other seed organisations. Surprisingly, the NDIA website links only to six of the seed sites: three key government disability agencies - NDISQSC, DSS and Disability Connect Queensland – and three peak bodies – NDS, FPDN and Carers Queensland. Clearly the NDIA does not see its role as connecting its web users to disability or mainstream organisations.
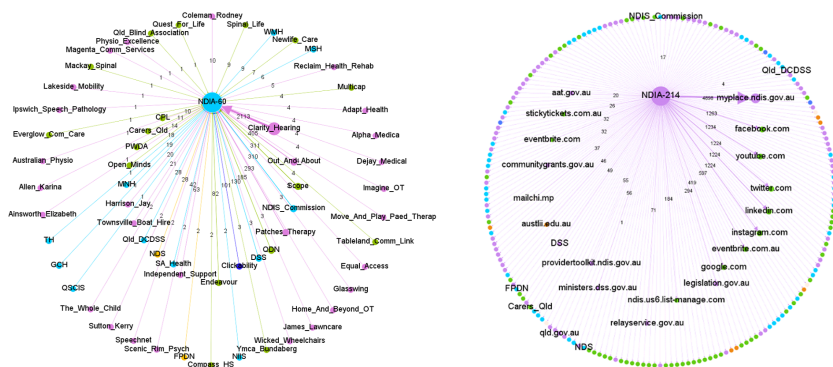
Figure 4. www.ndis.gov.au neighbours: inlinks (left); outlinks (right)

Within the full NDIS network of 8,637 websites, the NDIA website points to 214 websites, primarily government (.gov, 40%), commercial entities (.com, 32%) and organisational websites (.org, 22%). The inner circle of Figure 4 (right) shows the top 20 websites that ndis.gov.au points to. The largest number of links (4,898) is to myplace.ndis.gov.au, the NDIS's participants' portal. Notably, eight of the top ten are social media (Facebook, YouTube, Twitter, LinkedIn, Instagram) or internet tool sites (Eventbrite, google, mailchimp's list-manage), thereby reinforcing the critical role that these commercial internet companies play in contemporary governmental operations.

National Disability Services (NDS) (nds.org.au)

As the peak body representing non-government disability provider organisations, we anticipated that the NDS website was of a moderate-to-large size and would point to all its 1,200+ member organisations, as well as to the key government NDIS organisations. This was somewhat the case. With 1,051 webpages, the NDS website operates as a linker (reinforced by its high hub score) by pointing to 247 other websites, representing only a fraction of its members (Figure 5, right hand side). Within the 216 seed sites, NDS only linked to eight: three federal NDIS agencies; three state health organisations; and two advocacy bodies (PWDA and FPDN). About half are commercial (.com, 47%), and a quarter organisational (.org, 21%) and governmental (.gov, 21%). Social media sites Facebook, Twitter and LinkedIn are each pointed to over 500 times, along with online tools Vimeo (93) and EventBrite (73). Somewhat surprisingly, the NDS was not seen by other seed websites as useful to connect with, even though it is the peak body for disability provider organisations (Figure 5, left hand side). Only eight of the other 215 seed websites point to the NDS website: three government websites (DSS, Qld_DCDSS, NDIA),
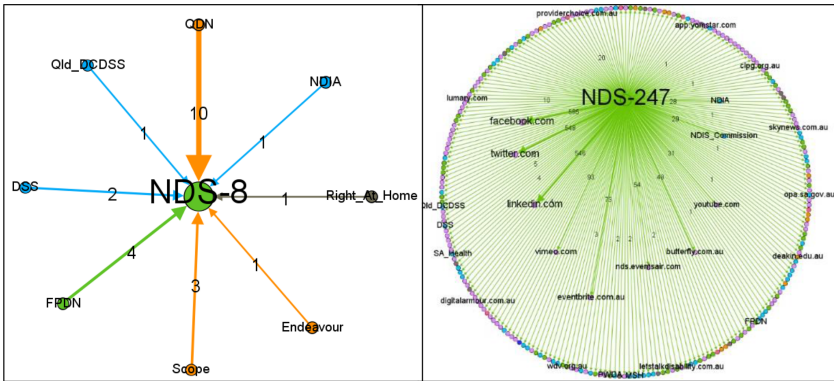
Figure 5. www.nds.org.au neighbours: inlinks (left); outlinks (right)

three NGO websites (Scope, QDN, Endeavour), one peak (FPDN) and one private/commercial organisation (Right At Home Brisbane South).

People With Disability Australia (PWDA) (pwd.org.au)

As a national disability rights, advocacy and representative organisation that is made up of, led and governed by people with disability, we anticipated that the PWDA website (657 webpages) would be important in the NDIS online network as a target of other websites referring NDIS participants to their website. Of the 216 seed websites, the PWDA website is the target from only five other organisations: two of the four advocacy organisations (QDN and FPDN); the federal government DSS; the peak disability services body NDS; and a commercial transport modification organisation (www.TotalAbility.com.au) (Figure 6, left). Unsurprisingly, social media websites were among the top 170 websites the PWDA website pointed to. National and international human rights, advocacy and legal organisations were among other major organisations to which the PWDA websites linked (Figure 6, right), reinforcing its position in a human rights/legal/advocacy institutional web ecology.

Clickability (clickability.com.au)

Coined as an Australian disability service directory, it was anticipated that Clickability would have a very large website and point to numerous organisations, which is what was found. Overall, its 11,933 webpages point to 1,418 – or approximately 1 in 6 – websites within the full network. These are mainly commercial (.com, 63%) and organisational (.org, 27%) websites (Figure 7). Their most linked neighbours are social media sites – Facebook (12,369 links), Twitter (12,217), LinkedIn (12,118) and Instagram (6,146) – and online tools – plus.google.com (6,069) and enable-javascript.com (664). The links to social
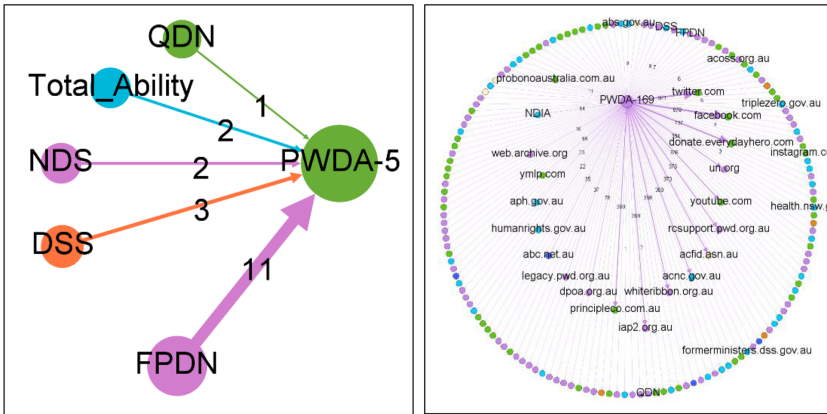
Figure 6. www.pwd.org.au neighbours: inlinks (left); outlinks (right)
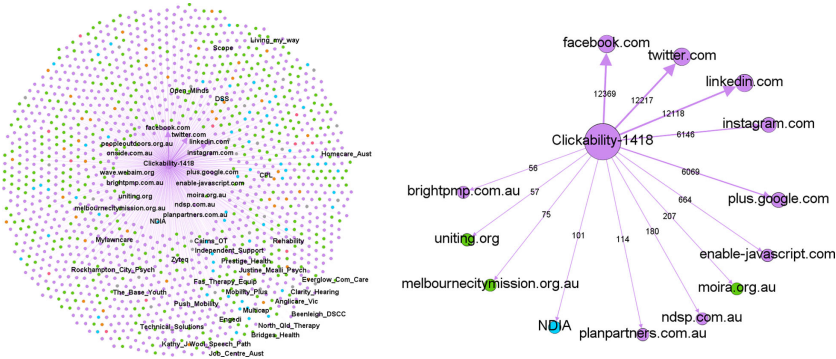
Figure 7. clickability.com.au: all outlinks (left); top 13 outlinks (right)

media sites are likely to be social media accounts of other NDIS provider organisations. Importantly, the Clickability website did not link to any of the five advocacy organisations in the seed websites, suggesting that its users are constituted as consumers of services, rather than citizens with rights.

Discussion and Conclusion

The study results demonstrate some expected and unexpected findings about the way in which Australia's quasi-marketised disability service sector is operating online. By charting the hyperlink web ecology of a sample section of the NDIS, insights into the possible institutional and information ecologies of the NDIS can be discerned.

First, the NDIS online network includes a large proportion (over half of the 216 seed sites) of primarily *small commercial organisations* providing

non-disability, but often allied health related, services that are not connected to the NDIS online network. These could represent new entrants to the disability system, who provide services to NDIS participants, and are primarily mainstream organisations. Notably, these organisations fail to demonstrate to their website users their NDIS provider role by pointing to key NDIS organisations, thereby missing out on potential clients.

Second, there are examples of new forms of *innovative organisations* using the internet to enter the disability system via the quasi-market and creating a big online presence. Clickability – a disability service directory – has embraced the power of the internet in a marketised choice environment to help people with disability find NDIS providers online. Remarkably, the government's own NDIA does not provide a similar service directory feature on its website. While Scope (scopeaust.org.au) has been in operation for 70 years, it too has demonstrated an innovative online presence (indicated by the high hub score) to help link people to the NDIS and provide a holistic one-stop-shop service, that most other traditional disability service organisations have not sought to emulate online.

Third, *peak and advocacy bodies* reassuringly have a significant presence online, with a dual role as linkers of website users to other organisations (evidenced by high hub scores) and as authoritative sites to which web users can go to for information and/or advocacy support (evidenced by high authority scores). Surprisingly, the NDS does not provide website users with links to all its member organisations. Rather the links are to key government policy, service and HSS organisations, social media and online resource organisations, and other peak bodies (such as the Australian Council of Social Services). This finding highlights the potential for peak organisations to link more explicitly to its member organisations online, and vice versa. The advocacy organisation PWDA showed significant online connections to NDIS government agencies, and distinctively positioned itself within a web ecology of national and international advocacy, legal and human rights organisations.

Fourth, as expected, the major *government NDIS related organisations* have a significant online presence, primarily through organisations linking to them, making them high authority websites. Despite having high hub scores, such government websites largely pointed to other government or official websites (not service organisations), and social media and online tools websites. Links to disability advocacy and service organisations by NDIS government agencies are quite limited and typically to peak and advocacy bodies only. This suggests that the NDIA does not see their role as directing people to diverse support and advocacy networks. This omission could limit capacity for 'choice and control', especially for people unsure how to navigate the offline system. Correspondingly, this highlights an area for NDIS to advance its online service delivery through better navigation of the scheme by linking participants to

providers, further information, understanding rights, and advocacy support, and at a local level.

Finally, *social media* and online digital tools (such as Eventbrite) have an essential and central presence in the NDIS network, demonstrating the critical role that these commercial internet companies play in contemporary governmental operations. This is perhaps unsurprising and was also evidenced in the operation of British and Australian government networks (Henman *et al.*, 2014, 2021). Social media in this context has the potential to connect NDIS participants to each other to share knowledge and lived experiences that can mutually benefit themselves and the evolution of the NDIS system.

These findings about the NDIS web ecology enhance our understanding of the institutional and informational ecologies of these organisations in the NDIS system. Online hyperlink relationships are not the same as formal institutional relationships, but they do reflect a certain level of inter-organisational connection. Indeed, the observation that many NDIS-registered organisations have no connections within the online NDIS network is a powerful indicator of their limited organisational connection within the NDIS system. While they may provide NDIS funded services, they are positioned separate to and perceive themselves disconnected from the NDIS network, a positionality they may benefit in revising.

The hyperlink networks also demonstrate flows of information in an informational ecology. This includes pointing website users to authoritative information, such as those of the NDIA, to useful organisational information and updates (e.g. on social media accounts), or to organisations who can provide or link to services (as Clickability does). This information ecology thereby suggests a wider service ecology of the NDIS. Apart from service brokers, hyperlinks variously point to organisations for advocacy, complaints, and appeals. The varied online visibility of these services also speaks to the operation of the NDIS system, and the (online) achievement (or otherwise) of efficiency, choice, transparency, and accountability, and designates the nature of NDIS participants as consumers with choice and citizens with social and economic rights.

Implications for organisations and government

This study has highlighted the opportunities the online world provides for the operation of the quasi-marketised system of services for people with disability. Websites provide organisations with the opportunity to present who they are and what they can do, as well as directly deliver services (e.g. advice and advocacy, online counselling, service, and finance management) and provide avenues for linking clients with other organisations. The evidence provided in this study demonstrates that direct service organisations have not yet developed their online presence strongly, though there may be considerable untapped benefit in doing so. This was particularly evident in the more mainstream service

organisations providing NDIS-funded services. A key exception is the wide-spread use by organisations of social media platforms for connecting with clients and other organisations.

This analysis also demonstrates that organisations could consider the value of social media platforms and the various roles exhibited by these, including for video hosting (YouTube), distributing information updates (Twitter) and inter-acting with users (Facebook and Instagram). As there is increasing progression towards the online world, organisations failing to operate online or through social media platforms may be limiting their online visibility, which can affect offline visibility and their organisational sustainability.

While online presence is increasingly essential for information and service delivery in the NDIS environment, complementary exploration of offline rela-tionships is necessary to fully comprehend organisational relationships and interfaces (e.g. see Foster *et al.*, 2021 for this project's offline data; Malbon *et al.*, 2019). Everyday analysis of inter-organisational relationships will also help discern their nature (e.g. informational, advocacy or service-related), how such relationships are changing, and what challenges arise in the NDIS service deliv-ery environment.

While disability services have traditionally been face-to-face (and need to continue as such), the role of the internet cannot be ignored. People with dis-ability increasingly use the internet for seeking health and service information, professional and peer support, and advocacy (Glencross *et al.*, 2021; Ramsten *et al.*, 2020). Indeed, the web also enhances access to government and services for many people with disability and their families, though challenges remain (Blackburn and Read, 2005; García-Crespo *et al.*, 2012; Mavrou *et al.*, 2017; Sartori do Amaral *et al.*, 2019). Policy makers could encourage NDIS-registered providers to have an online presence which is appropriate and accessible (e.g. using recognised web accessibility standards). Conversely, governments must ensure that online services do not displace other service channels (e.g. tele-phone, teletext) that some people with disability prefer. In creating quasi-markets, governments also have an important role in providing government independent and authoritative online service directories so citizen-consumers can navigate to service providers. Governments can also enhance the operation of the quasi-market by providing online rigorous assessments of service quality, just as TripAdvisor and NHS Choices (Gann and Grant, 2013) does for travel and health services, respectively. The online world is increasingly essential in everyday life, having brought new opportunities (and challenges) for people with disability. Disability and social care services need to be part of this world to avoid any further digital divide among people with disability.

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Conflict declaration

The author(s) declare none.

Supplementary material

To view supplementary material for this article, please visit https://doi.org/10.1017/S0047279422000691. The full network data in a .graphml file is available at https://doi.org/10.48610/284ef14.

Notes

1 https://www.ndis.gov.au/participants/using-your-plan/managing-your-plan/how-use-myplace-portal#access
2 A 'peak body' is a non-government organisation that advocates politically for its membership consisting of organisations (not individuals) with shared interests.
3 https://www.ndis.gov.au/participants/working-providers/find-registered-provider
4 .org domains are commonly used for websites of not-for-profit organisations and communities, though they may be used by anyone.
5 Interestingly, the most significant hub website was South Australia Health (#1), which was included as a seed site because of its provision of specialist disability aids. It was on the NDIA list of Queensland related registered organisations as 'Orthotics and Prosthetics South Australia'.

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