

Transforming our World through Universal Design for Human Development

*Proceedings of the Sixth International Conference
on Universal Design (UD2022)*



Editors: Ilaria Garofolo
Giulia Bencini
Alberto Arenghi



An environment, or any building product or service in it, should ideally be designed to meet the needs of all those who wish to use it. Universal Design is the design and composition of environments, products, and services so that they can be accessed, understood and used to the greatest extent possible by all people, regardless of their age, size, ability or disability. It creates products, services and environments that meet people's needs. In short, Universal Design is good design.

This book presents the proceedings of UD2022, the 6th International Conference on Universal Design, held from 7 - 9 September 2022 in Brescia, Italy. The conference is targeted at professionals and academics interested in the theme of universal design as related to the built environment and the wellbeing of users, but also covers mobility and urban environments, knowledge, and information transfer, bringing together research knowledge and best practice from all over the world. The book contains 72 papers from 13 countries, grouped into 8 sections and covering topics including the design of inclusive natural environments and urban spaces, communities, neighborhoods and cities; housing; healthcare; mobility and transport systems; and universally-designed learning environments, work places, cultural and recreational spaces. One section is devoted to universal design and cultural heritage, which had a particular focus at this edition of the conference.

The book reflects the professional and disciplinary diversity represented in the UD movement, and will be of interest to all those whose work involves inclusive design.



ISBN 978-1-64368-304-1 (print)

ISBN 978-1-64368-305-8 (online)

ISSN 0926-9630 (print)

ISSN 1879-8365 (online)

TRANSFORMING OUR WORLD THROUGH
UNIVERSAL DESIGN FOR HUMAN DEVELOPMENT

Studies in Health Technology and Informatics

International health informatics is driven by developments in biomedical technologies and medical informatics research that are advancing in parallel and form one integrated world of information and communication media and result in massive amounts of health data. These components include genomics and precision medicine, machine learning, translational informatics, intelligent systems for clinicians and patients, mobile health applications, data-driven telecommunication and rehabilitative technology, sensors, intelligent home technology, EHR and patient-controlled data, and Internet of Things.

Studies in Health Technology and Informatics (HTI) series was started in 1990 in collaboration with EU programmes that preceded the Horizon 2020 to promote biomedical and health informatics research. It has developed into a highly visible global platform for the dissemination of original research in this field, containing more than 250 volumes of high-quality works from all over the world.

The international Editorial Board selects publications with relevance and quality for the field. All contributions to the volumes in the series are peer reviewed.

Volumes in the HTI series are submitted for indexing by MEDLINE/PubMed; Web of Science: Conference Proceedings Citation Index – Science (CPCI-S) and Book Citation Index – Science (BKCI-S); Google Scholar; Scopus; EMCare.

Series Editors:

B. Blobel, O. Bodenreider, E. Borycki, M. Braunstein, C. Bühler, J.P. Christensen, R. Cooper, R. Cornet, J. Dewen, O. Le Dour, P.C. Dykes, A. Famili, M. González-Sancho, E.J.S. Hovenga, J.W. Jutai, Z. Kolitsi, C.U. Lehmann, J. Mantas, V. Maojo, A. Moen, J.F.M. Molenbroek, G. de Moor, M.A. Musen, P.F. Niederer, C. Nøhr, A. Pedotti, N. Peek, O. Rienhoff, G. Riva, W. Rouse, K. Saranto, M.J. Scherer, S. Schürer, E.R. Siegel, C. Safran, N. Sarkar, T. Solomonides, E. Tam, J. Tenenbaum, B. Wiederhold, P. Wilson and L.H.W. van der Woude

Volume 297

Recently published in this series

- Vol. 296 R. Röhrig, N. Grabe, V.S. Hoffmann, U. Hübner, J. König, U. Sax, B. Schreiweis and M. Sedlmayr (Eds.), German Medical Data Sciences 2022 – Future Medicine: More Precise, More Integrative, More Sustainable! – Proceedings of the Joint Conference of the 67th Annual Meeting of the German Association of Medical Informatics, Biometry, and Epidemiology e.V. (gmds) and the 14th Annual Meeting of the TMF – Technology, Methods, and Infrastructure for Networked Medical Research e.V. 2022 online in Kiel, Germany
- Vol. 295 J. Mantas, P. Gallos, E. Zoulias, A. Hasman, M.S. Househ, M. Diomidous, J. Liaskos and M. Charalampidou (Eds.), Advances in Informatics, Management and Technology in Healthcare

ISSN 0926-9630 (print)
ISSN 1879-8365 (online)

Transforming our World through Universal Design for Human Development

Proceedings of the Sixth International Conference on Universal
Design (UD2022)

Edited by

Ilaria Garofolo

University of Trieste, Italy

Giulia Bencini

Ca' Foscari University of Venice, Italy

and

Alberto Arenghi

University of Brescia, Italy



IOS Press

Amsterdam • Berlin • Washington, DC

© 2022 The authors and IOS Press.

This book is published online with Open Access and distributed under the terms of the Creative Commons Attribution Non-Commercial License 4.0 (CC BY-NC 4.0).

ISBN 978-1-64368-304-1 (print)

ISBN 978-1-64368-305-8 (online)

Library of Congress Control Number: 2022943405

doi: 10.3233/SHTI297

The image on the front cover represents the Winged Victory of Brescia, a bronze statue from the first century CE. The statue is preserved in the Roman Archaeological Park in Brescia.

Publisher

IOS Press BV

Nieuwe Hemweg 6B

1013 BG Amsterdam

Netherlands

fax: +31 20 687 0019

e-mail: order@iospress.nl

For book sales in the USA and Canada:

IOS Press, Inc.

6751 Tepper Drive

Clifton, VA 20124

USA

Tel.: +1 703 830 6300

Fax: +1 703 830 2300

sales@iospress.com

LEGAL NOTICE

The publisher is not responsible for the use which might be made of the following information.

PRINTED IN THE NETHERLANDS

Metropolitan MaaS and DRT Schemes: Are They Paving the Way Towards a More Inclusive and Resilient Urban Environment?

Iliaria DELPONTE^a and Valentina COSTA^{b,1}

^a*Department of Civil Chemical and Environment Engineering (DICCA), University of Genoa*

^b*Italian Center of Excellence in Logistics, Transport and Infrastructure (CIELI), University of Genoa*

Abstract. Mobility-as-a-Service and Demand-Responsive-Transport schemes are promoting progressively a user-centered approach, made of modularity, flexibility and tailor-made travel experience, and pandemic emergency has furthermore enhanced this new way of thinking, thus representing an unprecedented occasion to develop a new paradigm for a more sustainable and resilient transport system, thus ensuring a greater level of social and territorial inclusion beyond traditional urban borders and outdated distinctions of targeted services for particular users' categories. This paper discusses the main features of MaaS and DRT schemes in order to assess if they could be able to cope with Universal Design principles and to improve metropolitan accessibility accordingly to the urgent request for social and territorial inclusion as sustainable development pre-requisites, made by different stakeholders in the international and European debate (see UNO SDGs or EU Cork Declaration 2.0), and re-launched by many national initiatives (SNAI for Italy, Espana Vacía for Spain...). To re-think metropolitan mobility as a service that can be shaped accordingly to user's needs and to redefine transport supply as a complex puzzle made by different and complementary services could represent a unique opportunity to overcome one of traditional public transport dramatic problems: low mobility demand, whether it be due to sparsely populated areas or connected with specific demands of targeted population categories. Hence this paper recalls some of the recent DRT experiences already active in Genova Metropolitan Area -the so-called DRINBUS above all- along with the on-demand mobility strategy for Ligurian internal areas in order to discuss how this new user-centered approach is acting on the marginalization of remote territories and fragile user categories. The choice to develop a MaaS scheme could re-shape metropolitan mobility as a comprehensive and global mosaic made by multiple pieces, thus making more resilient the entire system thanks to its modularity and redundancy. This allows to make more sustainable "niche" services as well, according to the systemic nature of this mobility platform, thus opposing the present unsuccessful approach of creating ad-hoc options, focusing indeed on the user's request to travel from point A to point B, without the need to define him as urban resident, commuter, disabled or not, towards a greater social inclusion and territorial cohesion.

Keywords. Mobility-as-a-Service, Accessibility, Inclusion, Demand-Responsive-Transport, Universal Design

¹ Valentina Costa, University of Genoa-CIELI, Via Vivaldi 5, 16126 Genova, Italy; E-mail: valentina.costa@edu.unige.it.

1. Introduction

Public Transport in the last decades has been usually offered as a one-fits-all solution, that following its quantification, tries to meet mobility demand of a given territorial context through fixed routes and scheduled timetables (that become more frequent on peak hours and get sparser on non-rush hours).

Entry and Exit hours' time-shifting for workers and students, general population ageing and overall, a deep change in mobility routines, anyway, make transport demand more and more unsystematic, so that traditional PT offer doesn't fit any longer (ISFORT, 2019). Traditional PT offer, anyway, had already showed many criticalities in particular towards most vulnerable users, as the elderly and disabled citizens, or low-transport demand (be them urban peripheral areas or rural settlements) residents and following Covid-19 pandemic outbreak is experiencing a deep crisis (*Potter et al.*, 2021).

Subsequent lockdowns, social distancing, smart working and distance learning diffusion, e-commerce led to a sudden contraction of mobility demand (that nowadays in Italy is strongly re-bouncing (Italian Transport and Infrastructure Ministry, 2021) and to a radical change in mobility patterns.

That's why in these days gets more and more frequent the idea to define new mobility models able to guarantee flexibility, modularity, and customization. Demand Responsive Transport and Mobility-as-a-Service are now experiencing a world-wide spread.

Their diffusion doesn't have to be linked only to a greater resilience towards external events, and a consequent higher economical sustainability, but above all because this emergency period can represent a unique opportunity to rethink metropolitan mobility scheme towards a higher level of social inclusion and accessibility, towards an innovative and truly universal mobility offer.

High levels of service customization allow to meet different needs of different user segments, without the necessity to develop unpleasant ad-hoc solutions that in the past addressed specifically the elderly and the disabled, improving their mobility opportunities, thus defining special services, thought as exceptions, more than following a systematic approach towards universal accessibility.

In the following sections some of the experiences from Genoese Metropolitan Area will be explored (as the DRINBUS initiative and DRT for Internal Areas), in order to discuss how this innovative approach can contribute to shape a more inclusive and resilient urban environment, offering tailor-made mobility solutions to update one-fits-all traditional transport offer, according to Universal Design fundamental principles.

2. Universal Design principles and tailor-made mobility solutions

Speaking of Universal Design solutions' implementation in transport sector, the most common initiative concerns the "hardware" actions to guarantee universal access to mobility services.

Usually ex-post solutions are preferred, taking for granted actual mobility scheme and conceiving UD principle of social inclusion as a purpose to be reached through progressive corrections and updates in the long term.

Anyway, as previously introduced, Universal Design aims at more ambitious goals than a simple, thus necessary, ex-post adaptation process: re-thinking the whole services offer and use schemes must be the real objective.

That's why it's particularly important to understand how deeply and significantly innovative solutions as Mobility-as-a-Service and Demand Responsive Transport can affect social inclusion and land accessibility issues: this strong link can find clear explanation referring to Universal Design basic principles.

Looking at the seven key principles introduced by the *Centre for Universal Design at North Carolina State University* in 1997, the connections between this kind of new mobility initiatives and the main universal and inclusive design goals appear direct and evident.

MaaS and DRT implementation represent firstly an equitable and flexible use guarantee. Travel choice modularity and customization, starting from the simple definition of departing and arrival points, are the key features of these new mobility schemes. According to personal capabilities, characteristics and needs, user can choose between different travel alternatives given by MaaS platform, without the necessity to fit in a standard PT offer or rely on his/her own car. Likewise, on-demand services allow usually high customization levels in terms of routes, stops and time to meet universal mobility needs, children, the elderly, and the disabled above all, thus reducing physical effort, too, offering door-to-door solutions. Planning, reservation, and payment operations in both cases are available as simple, intuitive, and seamless functionalities of a digital application, specifically designed to be clear, universally, and easily accessible. The idea is basically to provide universal accessibility to mobility services in order to overcome traditional barriers separating urban and non-urban services, local users and commuters, people who have mobility impairment and people that don't.

Hardware (transport vehicles above all) and software (apps and websites) components goal is not to offer "special" functionalities and infrastructures for specific users' categories, but to introduce a new user-centred approach to meet the user's needs in a targeted and customized way, thus granting a widespread and greater accessibility level.

This principle leads to the use of vehicles that enable people to hop on and off without limitations or barriers of any kind, that are by default designed to meet mobility needs of every user's category and to the implementation of digital platforms which ensure an easy and intuitive use regardless of the user's capabilities.

In this regard, the new perspective offered by Mobility-as-a-Service paradigm, where users are the key element of transport supply which shapes around him/her and his/her need to get from point A to point B, allows to define tailored solutions, without the need to pre-design specific (thus segregating) ad hoc options to target user's features and necessities.

This innovative and holistic approach overcomes the initial steps of DRT services implementation where they were usually designed to meet transport demand of some "fragile" user's categories (the elderly, disabled..), enhancing their autonomy and self-reliance, their capability to reach essential services, thus making it in a special and different way from the majority of users, supporting in some way those involuntary segregation which *Preiser and Smith* (2011) blame as a failing attempt of social inclusion and engagement.

3. Territorial accessibility

Social inclusion and accessibility improvements are often discussed in relation to specific users' segments who risk social segregation from the rest of the community due to their mobility impairments linked to physical, economical, age reasons.

It's necessary thought to recall that one of the main pre-conditions to individual mobility is undoubtedly represented by spatial and territorial asset. Local context is at the basis of every individual mobility limitation, thus risking exacerbating personal criticalities.

That's the reason why mobility services planning activities often pay particular attention to low-transport demand areas. Low-transport demand areas are specific land portions where historical, economical, geomorphological and settlement contingencies are characterized by a poorly dense e little transport demand, so that defining and implementing traditional PT services is particularly unfavorable.

Low-transport demand areas can be found among different local contexts: they can be urban peripheral neighborhoods, hilly or rural settlements, where a complex array of urbanization, orographic, social, and economic factors determine low potential for transport demand (ART, 2018).

The impossibility for local administrations to sustain traditional PT services supply in these contexts often led to substantial cuts to the local PT coverage and extension, thus making personal cars the only way to reach urban hubs, especially during off-peak hours. It's clear that unsystematic mobility boom made this issue even more dramatic.

Peripheral areas accessibility is nowadays pivotal in sustainable development debate on every scale. UNO SDGs in 2030 Agenda, as well as EU Cork 2.0 Declaration, focus on the need to promote an inclusive and universal development scheme, through the engagement of the communities that remained on the fringes of global economic and social growth: this represents the only way to slow down wild urbanization processes, to maintain some level of territorial presence and to design new sustainable development strategies. On a national level, Italy has defined too a National Strategy for Internal Areas in 2013 to focus new attentions and energies on peripheral contexts that went through marginalization and depopulation processes.

To define "universal" mobility services, able to include and not segregate, to engage and involve, is thus fundamental a user-centered approach, not only for individual reasons, but in territorial sense too. Contemporary transport supply has to meet the users' needs overcoming traditional physical and social barriers but getting over those visible and invisible borders that nowadays separate central and peripheral areas, urban and rural contexts.

4. Genova Metropolitan City experiences

To investigate how MaaS and DRT solutions can pave the way towards a more resilient and inclusive urban environment, thus meeting UD principles and needs, it can be interesting to refer to a couple of mobility experiences from Genova Metropolitan Area.

Genova Metropolitan City is located in North-Western Italy, with an 1830 sq.km surface, 67 municipalities and 820 000 inhabitants.

It is a very peculiar and complex context, a thin land stripe between the Mediterranean and the Alps, where urban settlements develop mainly along the coastline, while on the hills only small and rare villages can be found.

Concerning PT services, Genova Metropolitan Area is particularly remarkable as an only operator manages the entire network (with the only exception of railways where a national operator is present). This framework, which is common only to another couple of metropolitan areas in Italy, represents a particularly favorable factor in order to implement MaaS and DRT solutions supporting traditional PT offer.

This is one of the main reasons why several initiatives were launched to support a gradual process of network and fares integration on local transport services (including PT, sharing services, taxi...) to define a metropolitan MaaS platform able to re-shape a new seamless, tailored, and inclusive mobility offer.

Among these re-design operations, regarding PT component, a specific focus was centered on DRT services. New DRT offer followed two lines of action which both aimed at a more responsive and sustainable way to meet transport demand of low-density areas and most marginalized users' category. According to a user-centered approach it was decided to implement a similar alternative for two very different contexts, which traditional PT services treated in a completely dissimilar way: hilly settlements of Genova Municipality and the peripheral and rural municipalities included in the National Strategy for Internal Areas.

Two on-demand services with pre-defined stops where implemented, focusing on the need to enhance local accessibility, regardless of the initial territorial context and focusing only on the users' perspective and centrality.

According to this approach, particular attention was paid to the equipment of vehicles that respond to updated standards for people with disability and mobility impaired, thus granting universal access also due to the reduction of physical effort thanks to the tailoring potential of DRT solutions.

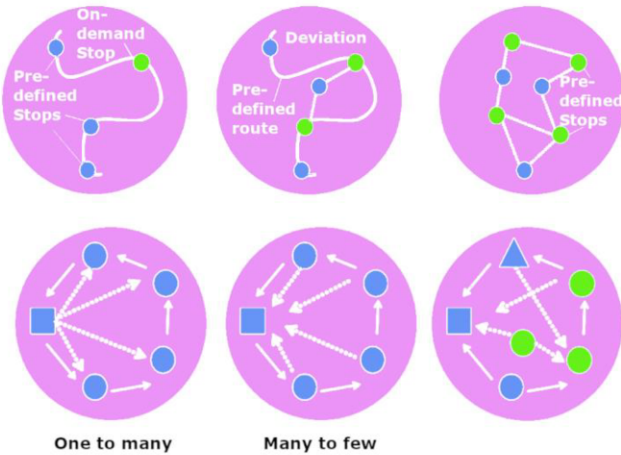


Figure 1. DRT service schemes.

DRINBUS urban experience, was born at the beginning of 2000s, to support traditional PT network in the most peripheral Genoese neighborhoods where residential areas climbed on the hills behind the coastline, without a proper PT coverage. This initiative grew fast in terms of users' appreciation, territorial and time extension.

Nowadays a further expansion would significantly concern some municipalities which are strongly physically and functionally linked to Genova (even though separate for administrative purposes), thus remarking the need to conceive metropolitan mobility as an integrated and flexible system, that overcome traditional and outdated boundaries.

The second experience, which is currently in the pilot phase, concerns a non-urban context, of the Internal Areas identified by the National Strategy, the Antola-Tigullio Area, that includes 16 municipalities from Genoese inland area, where less than 20 000 inhabitants live on a very wide territory, in poorly dense settlements.



Figure 2. Antola-Tigullio DRT pilot vehicles.

Another on-demand service with pre-defined stops was designed along different routes in order to meet several kinds of mobility-demand: municipalities immediately close to Genova demand for direct and fast connections, most peripheral contexts require a local service to link different hamlets.

Briefly introducing these initiatives allows to remark the key issue: travel experience maximum customization, in spatial and time terms, is not convenient for users' accessibility and inclusion only, it enables PT operator to apply similar solutions even to profoundly different contexts, thus determining financial and sustainability advantages due to the economy of scale principle (Mageean and Nelson, 2003).

It is particularly interesting to compare these initiatives which locate in very different moments of their implementation process: DRINBUS dates back to more than 15 years ago, while Antola-Tigullio DRT pilot started in February 2022. They represent

in some way two DRT generations: the first one, from the beginning of 2000s, substantially experimental, that tried (technological issues were much more present) to support and integrate urban network to allow non-car users to reach local hubs (sport facilities, commercial areas) that weren't included under traditional PT coverage; while second and contemporary generation seamlessly fits in metropolitan network, without representing a plan-B solution, and making PT more responsive and widespread, indeed.

This time-shift represents a substantial mind-shift, too. Accessibility and mobility have meanwhile become universally recognized rights to be granted to everyone independently from their age, status, origin or physical condition. Customization of vehicles and services has become a necessary pre-condition to fight territorial and social marginalization in a much broader sense: from being a technical solution to reduce costs and enlarge PT users' base to a spread paradigm to assure accessibility thanks to a greater and integrated network, that enables users to reach more destination without the need to increase physical or economic effort.

5. Conclusions

It's clear that accessibility and social inclusion are essential pre-requisites to define a new development scheme for more resilient and sustainable urban environment. Only through equal opportunities in terms of reaching basic services and involvement in social and economic relations (which are key features of urban contexts) regardless of physical conditions, age, and territorial origin it's possible to re-think cities able to face contemporary challenges, climate change above all.

In this direction, making mobility more integrated and tailored, shaping new transport offer to cope with long-distance travel and last mile displacement as well, providing several services that can be easily booked and bought seamlessly, represent the key strategy to put users' needs at the center of urban environment. This is pivotal not only on a conceptual level, but it's even undelayable looking at the present situation. Even though PT is constantly bouncing back from Covid-19 pandemic outbreak, it's self-evident as well that it's necessary to re-design its supply to guarantee economical sustainability, but above all to make it closer and more responsive to a transport demand which is deeply changed.

PT supply will have to follow this change, leaving traditional standardization on pre-defined routes and timetables behind, to reach more flexible and tailored configurations. To re-think mobility as a service, as a modular and redundant system, able to cope resiliently with external shocks, ensure PT economical sustainability, but above all to make users base greater than in the past.

User centered perspective (which is at the basis of MaaS concept) indeed implies to respond to transport demand with door-to-door solutions, often through on-demand alternatives, thus integrating long-distance solutions with last-mile options. This comprehensive approach allows to involve users' segments that need to minimize physical effort for age or mobility impairments reasons, thus offering them the opportunity to directly reach their destination.

This deep change in mobility scheme allows a further step: traditional separation of urban and non-urban services can be overcome, leaving behind the idea that PT substantially belongs to urban centers, providing an integrate transport offer able to make metropolitan mobility easy, flexible, and seamless.

Software and hardware (in terms of infrastructure and vehicles equipment) measures are progressively directing Genoese mobility towards universal accessibility: tailored services and vehicles universal design grant users to reach more destinations, to answer their needs, in an equitable and flexible way, reducing physical effort thus removing visible and invisible barriers of any kind.

Genoese experiences allow to foresee one the possible strategies to follow towards a metropolitan environment that must become more and more inclusive, connected and universally accessible.

References

- [1] ISFORT (2019). 16° Rapporto sulla mobilità degli Italiani. <https://www.isfort.it/progetti/16-rapporto-sulla-mobilita-degli-italiani-audimob/>
- [2] Italian Infrastructure and Transport Ministry (2020). Osservatorio sulle tendenze di mobilità durante l'emergenza sanitaria del COVID-19. <https://www.mit.gov.it/node/15017>
- [3] Jittrapirom, P., van Neerven, W., Martens, K., Trampe, D., & Meurs, H. (2019). The Dutch elderly's preferences toward a smart demand-responsive transport service. *Research in Transportation Business and Management*, 30. <https://doi.org/10.1016/j.rtbm.2019.100383>
- [4] Mageean, J., & Nelson, J. D. (2003). The evaluation of demand responsive transport services in Europe. *Journal of Transport Geography*, 11(4), 255–270. [https://doi.org/10.1016/S0966-6923\(03\)00026-7](https://doi.org/10.1016/S0966-6923(03)00026-7)
- [5] Martens, K. (2013, January). Priority setting for an inclusive transportation system. *Transportation Research Board*, 92. Annual Meeting, Washington DC, USA <https://www.researchgate.net/publication/236119808>
- [6] Odeck, J., Hagen, T., & Fearnley, N. (2010). Economic appraisal of universal design in transport: Experiences from Norway. *Research in Transportation Economics*, 29(1), 304–311. <https://doi.org/10.1016/j.retrec.2010.07.038>
- [7] Potter, S., Enoch, M., Valdez Juarez, A. & Cook, M. (2021, 5 July-6 July). Demand Responsive Transport: is Milton Keynes developing a post-Covid revolution in public transport? Universities Transport Study Group, 53. Annual Conference, University of Loughborough, UK [Online]
- [8] Preiser, W.F.E., & Smith, K.H. (2011). *Universal Design Handbook* (2.ed.). McGrawHill
- [9] Rönkkö, E., Luusua, A., Aarveaara, E., Herneoja, A., & Muilu, T. (2017). New resource-wise planning strategies for smart urban-rural development in Finland. *Systems*, 5(1), 1–12. <https://doi.org/10.3390/systems5010010>
- [10] Sakib, N., Appiotti, F., Magni, F., Maragno, D., Innocenti, A., Gissi, E., & Musco, F. (2018). Addressing the passenger transport and accessibility enablers for sustainable development. *Sustainability* (Switzerland), 10(4). <https://doi.org/10.3390/su10030903>