Looking to the future: guidelines for decision support as adaptation practice matures

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Abstract

In this final paper, the guest editors identify and discuss ten guidelines emerging from the papers in this Special Issue on Decision-Support Tools for Climate Change Adaptation. The guidelines are arranged under three headings: foundational, design and construction, and supporting sustainability in the long term. Under foundational, we address the need for co-operation with end users of decision-support resources, the contribution these resources can make to the formation of thriving communities of practice, and the match between the different types of decision support and user needs. Under design and construction, we point to the risk that policy settings will change over the multiple years required to build and publish complex decision-support resources, reducing the relevance of the final product. We discuss the need for innovative approaches to ensure visibility, credibility and hence uptake. Developers should be mindful of the requirements, resources and capabilities of potential users at all points in the design and build. We also suggest that decision-support resources may be transferable between sectors and locations, but the motivation should be around achieving excellence, and not just cost savings. Under supporting sustainability in the long term, we stress the need for evaluation and comparative studies of performance, leading to carefully documented updating and improvement of decision-support resources. Finally, in the conclusions, we look to the future. Can decision-support resources evolve successfully to meet the information and guidance requirements of the increasingly sophisticated adaptation practitioner community?

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1 Introduction

In this Special Issue, we have presented 11 papers covering many contemporary issues around climate adaptation decision support, from the perspectives of adaptation platform and decision-support tool developers. In this final paper, we, as the guest editors for the Special Issue, share our thoughts on ten guidelines that emerge from these papers. These are not sufficient to ensure that a decision-support resource will be effective, but they are necessary for developers to bear in mind throughout if the final product is to be judged a success. These guidelines fall under three headings: foundational, design and construction, and sustainability in the long term.

Throughout, we have struggled with definitions and nomenclature around support mechanisms for adaptation decision-making. In the first paper of this Special Issue, Palutikof et al. (submitted) attempt to address this by providing a set of definitions (Box 1 in that paper) and an illustrative figure. Drawing on these definitions, here, we use the term *adaptation platform* to refer to a comprehensive resource 'equipping decision-makers with the data, tools, guidance and information needed to adapt to a changing climate' and *decision-support tool* to refer to 'methods and other knowledge resources that facilitate decision-making for adaptation to climate change' (Palutikof et al. submitted). That is, adaptation platforms can contain (collections of) decision-support tools; the reverse is not the case. When we generalise across the diverse types of decision support, we refer to these as *decision-support resources*.

2 Foundational guidelines for decision-support resources

2.1 The need to involve practitioners

A common theme in the Special Issue papers (see, for example Laudien et al. 2019; Leitch et al. submitted; Palutikof et al. 2019a) and in the literature more broadly is the drive to involve users in the design and production of enabling resources for decision support. This drive is partly in response to, first, a widely held view that usage of these resources is below the expectations of funding agencies and below the aspirations of developers (Hewitson et al. 2017) and, second, that engaging users would enhance relevance, usability, legitimacy and credibility (Cash et al. 2003; Meadow et al. 2015; Prokopy et al. 2017). Many of the papers presented in this Special Issue focus or touch on methods to increase user participation throughout the life of decision-support resources and barriers that stand in the way (e.g. Leitch et al. submitted).

Typically, developers undertake in-depth *engagement and consultation* with potential users to understand requirements, prior to and during the construction phase. There is a growing sense that simply to consult is insufficient, and that there needs to be *co-development*, in which developers solicit input from representative end users, if not the more involved *co-production*, where developers and users work on a more equal basis to drive the evolution of decision-support resources. As Measham et al. (2011) have shown, there are barriers to implement these strategies, notably that potential practitioner contributors are time poor, managing many competing demands among which adaptation is not the highest priority. As a result, what developers claim to be co-development and co-production may on inspection prove to be more like engagement and consultation. Nevertheless, if successful, a programme of co-development and co-production or, perhaps more precisely, 'coordinated development' (in which developers and end users work together), can help the final product become relevant, accessible and trusted.

Guideline 1 Practitioner involvement Co-development and co-production are resource-intensive activities but can deliver decision-support resources that are relevant, trusted and used by the target audience.

Further reading in this Special Issue All papers in this Special Issue touch on co-development and co-production of decision-support resources. Leitch et al. (submitted) present a systematic start-to-end overview of the processes undertaken to ensure practitioner involvement at all points in the design, build, release and evaluation of CoastAdapt.

2.2 Communities of practice

During the consultation, a need widely expressed by adaptation practitioners is for active communities of practice: well-networked groups providing an opportunity for meaningful exchange of information and experience. Are adaptation platforms an appropriate mechanism to facilitate the formation of thriving communities of practice? To what extent are community of practice interactions better promoted through professional bodies such as the American Society for Adaptation Professionals, set up in 2011, networks such as the Asia Pacific Adaptation Network and regular conference series such as the biennial international Adaptation Futures conferences, the biennial series of the European Conference on Climate Adaptation or the biennial National Adaptation Forum in the USA? Or is the optimum approach some combination of these which includes adaptation decision-support tools and platforms?

Professional societies and meetings derive their value from the benefits they generate for participants. Societies facilitate interactions intramurally or with relevant experts in other disciplines. Members are motivated to participate because they gain professional opportunities through peer interactions. Societies are often the first port of call when members are seeking advice or looking for support. Conferences persist and grow through active participation. Professional, peer-to-peer interactions already occur in these settings, so these provide obvious focal points for establishing climate adaptation communities of practice.

Although potentially effective supportive fora, there are barriers to participation in professional societies and conferences, principally exclusivity and the cost of participation, as well as the lack of awareness that they can provide such support. Some groups are more affected by these barriers while at the same time being the most likely to profit by having access and being engaged, for example researchers and practitioners from developing countries, students and early career professionals. Efforts are needed to reach out to and enhance the accessibility to decision-support resources by these more affected groups, including providing accessibility at low to no cost.

As Webb et al. (2019) suggest in this Special Issue, adaptation platforms can contribute to the formation and maintenance of communities of practice. To achieve this, they must be regularly updated (and therefore understood to be legitimate and credible by users), and actively engage user communities (for example through in-person training that utilises resources or online forums provided by the platforms) as part of a package of broad-based initiatives targeting and enhancing users' experiences. Through online and in-person trainings, Gardiner et al. (2019) employed their Steps to Resilience framework to contextualise the variety of resources available through the US Climate Resilience Toolkit. Supplemental training through workshops, manuals etc. may be needed to maximise users' benefits from using these resources.

Guideline 2 Communities of practice Web-based tools offer some strong advantages over professional societies and conference series—they are low cost, accessible to all and available at all times. If they capitalise on this advantage, they can complement other initiatives to create and maintain active and useful communities of practice.

Further reading in this Special Issue Webb et al. (2019) explore the relationship between adaptation platforms and communities of practice, and how each can contribute to the formation, ongoing robustness and effectiveness of the other.

Gardiner et al. (2019) discuss a way of tracking accountability to users through the Quality of Relationship developed for the US Climate Resilience Toolkit.

2.3 Matching decision-support resources to user needs

The landscape of adaptation is rapidly shifting in response to drivers such as government policy, sector requirements (e.g. stress testing, regulations and standards), increased demand and maturity of that demand, maturing experience in the adaptation community and the availability of climate change services tailored to adaptation requirements.

Over time, adaptation is changing from an activity undertaken in parallel with and sometimes in isolation from day-to-day organisational operations, to one which is mainstreamed into the core business. Where do the many and varied adaptation decision-support resources sit within this changing landscape?

Organisational capability, activity and the demand for tools evolve over time, beginning with an awareness that climate change should be considered in decision-making and moving toward a systematic understanding of how to incorporate climate considerations into all aspects of long-term planning and operations (Fig. 1). Adaptation platforms are particularly appropriate where capability is low and system-wide action is being contemplated. However, platforms may be too elaborate to support single adaptation projects, when more focussed decision-support tools may be more appropriate. For system-wide adaptation in high-capability organisations, it is likely that the activity can and should be mainstreamed into standard organisational risk management procedures.

Guideline 3 Proportionality The needs of adaptation practitioners for decision-support resources are differentiated by the complexity of the task and the capability of the decision-maker. Adaptation platforms are particularly effective in providing support where capability is low and ambition to undertake system-wide adaptation is high.

Further reading in this Special Issue Laudien et al. (2019) describe the application of their Climate Adaptation Atlas in stress testing.

Tonmoy et al. (2019) describe a three-tier risk assessment process for adaptation, in which users may iteratively select the complexity of assessment appropriate to their resources, expertise and requirements.
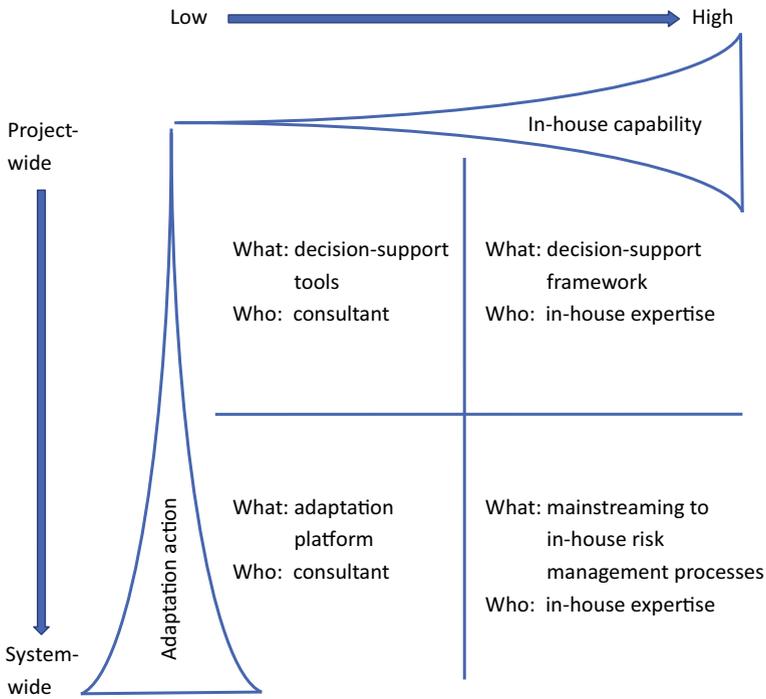
Fig. 1 Matching decision support to capability and adaptation task. The needs of organisations with respect to decision-support resources change depending on in-house capability and the task in hand (adaptation action). The figure shows what resources are appropriate for different tasks/capabilities, and who is likely to make use of these resources

3 Design and construction of decision-support resources

3.1 The passage of time

The policy and institutional contexts within which adaptation takes place are fluid. The design, construction and implementation of decision-support resources, particularly the more complex adaptation platforms, takes time, typically 3–4 years. Together, these two facts mean that by the time developers are ready to release an adaptation platform, it may no longer fulfil the criteria of relevance, usability and legitimacy (Cash et al. 2003). This may occur, for example if the type of adaptation a platform is meant to support is no longer being undertaken due to a policy or practice shift from whole-of-system adaptation to single projects or vice versa (Clar and Steurer 2018). Strategies that can be deployed to ensure that the implemented product is relevant to the existing adaptation context include flexibility, attention to emerging trends and ongoing engagement with stakeholders.

Guideline 4 Time dependence Ensuring relevance of adaptation decision-support resources from inception to release requires developers to be flexible, undertake meaningful and sustained stakeholder engagement and pay close attention to emerging adaptation policy and practice trends.

Further reading in this Special Issue Laudien et al. (2019), in their seven lessons learnt, point to the need for flexibility in project design in order that the decision-support resource can evolve over time to match the needs of practitioners.

3.2 Strategies to promote uptake

Most adaptation decision-support tools and platforms are designed and built by specialists in climate change adaptation, working within the research community or government agencies. Unless tools and platforms come directly from the target sector or location, language and terminologies from climate science and adaptation may be unfamiliar, confusing or even hostile to the target audience. As such, the uptake by intended and potential users may be low (Newman et al. 2017).

A typical user might be an engineer from the water supply sector, charged by their line manager to explore company exposure to climate change. With little knowledge of climate change, such a user may find the language and indeed the assumptions of an adaptation platform unfamiliar, difficult to use and essentially 'off-putting'.

Against this background, there are a number of strategies that decision-support resource developers can employ to promote uptake. In the first instance, they can work to ensure ease of navigability and inclusiveness of language, but this may be insufficient. Use of familiar datasets and data portals and standard processes such as ISO 31000 for risk management or ISO 14090 on adaptation, will all provide comfort to users. A further strategy might be to align adaptation decision-support resources with climate change information and guidance disseminated by professional societies/peak bodies, including the use of appropriate language, sharing text and datasets and mutual promotion. To support this, efforts should be made to ensure resources are linked from or embedded in professional societies' web platforms.

Guideline 5 Uptake Innovative approaches are needed to achieve visibility and credibility, and hence uptake of decision-support resources. These might include using datasets and standard procedures (e.g. for risk assessment) that are familiar to target users and aligning with climate change information and guidance disseminated by professional societies/peak bodies.

Further reading in this Special Issue Gardiner et al. (2019) have made concerted efforts to align their Steps to Resilience framework with a variety of disciplines and make it compatible with international standards. They actively socialise these steps through webinars and in-person training for professionals in many disciplines across the USA.

Tonmoy et al. (2019) describe a three-tier risk assessment process which exemplifies best practice by reinforcing the terms, definitions and procedures of ISO 31000.

Palutikof et al. (2019b) describe how they planned to design CoastAdapt as a portal to existing datasets, but eventually decided these were too hard to use. Instead, datasets tailored to target user requirements were generated.

3.3 One size does not fit all

Developers need to recognise that there are differentiated capacities and resources, as well as access to appropriate data to underpin decision-making (for example future coastal inundation scenarios based on LiDAR). In this Special Issue, Fünfgeld et al. (2019) explore the choices

made when practitioners (in the health sector) are supported to select their own resource for decision support. They show that opportunities for in-depth collaboration and discussion (with experts) are essential if organisations are to select appropriate decision-support resources and adjust these to match their contexts and needs.

Tools to support adaptation should be context-specific, proportionate to the task in hand, employing appropriate language and mindful of the competing demands on users—a tool which demands hours of time for familiarisation is unlikely to be widely taken up.

Guideline 6 Capability matching Developers should be mindful of potential users throughout the design and build of an adaptation decision-support tool or platform, especially the need to address potential barriers to take- up—lack of user capability, time and resources.

Further reading in this Special Issue Palutikof et al. (2019b) describe bringing potential users of their adaptation platform into a Tool Development Partnership, which worked with the developers at every stage. Taking this approach ensured the content of the adaptation platform closely matched user needs and capabilities. They further describe how web content in CoastAdapt is delivered at three levels of detail and complexity: 'skimmer', 'wader' and 'diver'.

3.4 Translation and adaptation

Adaptation decision-support tools and platforms are resource intensive to design and develop, in terms of both cost and time. Reasonably, therefore, developers (and funding agencies) often consider whether an existing adaptation decision-support resource can be effectively translated and adapted to match the specific contextual requirements of a new location/sector. (Note that here we use 'translation' in the sense of moving something from one place or context to another rather than in the sense of language translation only.)

Adapting and translating an existing decision-support resource confers benefits beyond resource efficiency in that it should build on the credibility and experience embodied within the original resource and its community. This Special Issue includes examples from Street et al. (2019) of adapting and translating the UK Adaptation Wizard for application in Portugal and Brazil and from Gardiner et al. (2019) of the application of the US Climate Resilience Toolkit to ten distinct and diverse topical areas.

Taking the case of the Adaptation Wizard, a strong consideration in deciding to adapt or translate it was the excellence of the original resource. The success of the process was ensured by the availability of supportive resources, existing experience in adapting and translation, and technical support from the developers. Without these in place, the process might not have succeeded. In considering which resources can and cannot be adapted, it should be recognised that some have suggested that decision-support resources that are context-specific and targeted perform better than those that seek to address more general requirements (Förster et al. 2015; Cortekar et al. 2016; Nkoana et al. 2018) and it is perhaps less likely that the latter would lend themselves well to such adaptation and translation.

Guideline 7 Translation Decision-support resources may be successfully translated for use in different sectors and locations, especially where the primary aim is to take advantage of the existing credibility and experience embodied in the original resources. Past successes suggest effective translation requires close collaboration between users and experts in the targeted sector or location, along with scientific and technical support from the original developers.

Further reading in this Special Issue Street et al. (2019) discuss the process of translating and adapting their adaptation planning resources from one country to another, and the related challenges of language and contextual translation, including consideration of different governance and policy arenas.

4 Supporting sustainability in the long term

4.1 Evaluation

Hewitson et al. (2017) point clearly to the lack of independent medium- to long-term evaluation of the take-up and utility of adaptation decision-support tools and platforms. Most adaptation platform managers scrutinise their Google Analytics. However, even though the number of site visits may remain high, it is not clear who the users are, what use they make of the platform or, perhaps most importantly, whether they represent the planned target users. In this Special Issue, Gardiner et al. (2019), Hasse and Kind (2019), Laudien et al. (2019) and Palutikof et al. (2019a, b) all describe a number of approaches to evaluation, carried out at different points in the lifetimes of their adaptation platforms.

There is a considerable investment of resources (financial and human) in adaptation platform development and maintenance. If they are not being made use of for their original purpose, platform developers and funders need to understand why and what would be better fitted to the purposes they seek to address. Evaluation and engagement methods can help discern uptake within targeted communities of users and professions. Longitudinal studies might reveal changing perceptions of relevance or credibility.

Guideline 8 Evaluation Independent medium- to long-term evaluation of adaptation platforms is required to understand whether they are effectively fulfilling their original purpose and, if not, why not.

Further reading in this Special Issue Gardiner et al. (2019) describe the use of five metrics to evaluate the 'Quality of Relationship' between the developers and users of their Climate Resilience Toolkit.

Hasse and Kind (2019) describe the evaluation of the Klimalotse after several years of operation, to ascertain its continuing relevance in the context of changing user needs.

Laudien et al. (2019) evaluate their adaptation web portal, leading to the identification of seven lessons learnt.

Palutikof et al. (2019a, b) describe how they evaluated the beta version of their adaptation platform through surveys, workshops and 6-week test cases.

4.2 Comparative studies

In-depth evaluation can form the basis for comparative studies of relative performance, responding to questions from users as to which decisions-support resources should be used for

which tasks. These studies could be formalised into the independent application of different tools to the same problem, comparison of the results and their impacts on decisions. Such studies would not only provide a greater understanding of the utility of the different approaches but also of the robustness of different tools and would point to areas needing further development.

Sharing knowledge and experience of adaptation platform and decision-support tool use by different communities can play a useful role in learning, capacity building and informing the use of existing resources, in building trust within user communities, in targeting efforts where further capacity building is needed and in identifying the need for any further development of decision-support resources. In particular, sharing comparisons of user experience is vital if the field of decision support is to grow effectively and to demonstrate relevance in meeting practitioner needs.

Guideline 9 Comparison In-depth comparative studies could help all adaptation decision-support resources by enhancing relevance, confidence and trust, improving user experience and bolstering decision-support outcomes.

Further reading in this Special Issue Fünfgeld et al. (2019) describe a project in which health and social service delivery agencies in Victoria, Australia, were led through a process to identify and select decision-support resources that fitted their circumstances.

Webb et al. (2019) survey 300 individual support products and services, including 30 general adaptation portals. Overall, they conclude that significant improvements are possible, around how to meet diverse needs authoritatively while avoiding unnecessary fragmentation, and how to build on promising but incomplete national and sub-national initiatives.

4.3 Renewal and documentation

Careful and visible documentation on the status of an adaptation platform or decision-support tool over the long term is essential to preserve its legitimacy and credibility with users. This documentation should include when updates were performed, what was updated and by whom. It could include whether there is an active programme of tool support, evaluation and improvement, as well as the availability of case studies. This documentation should demonstrate that (a) time-sensitive information, for example on government policy relevant to adaptation or related to the rapidly evolving field of climate science, is being regularly revisited and updated; (b) regular checks for broken URL links are being performed and (c) the adaptation resource is being actively renewed through the addition of new data and case studies on adaptation.

Without this continued attention, relevance will diminish. Users will gradually drift away out of concern that decisions based on the available approaches and information in the platform will be indefensible and may even leave them open to litigation.

Guideline 10 Renewal Active updating and maintenance of an adaptation platform or decision-support tool, accompanied by clear and visible documentation, will ensure continued relevance and sustained viability, and hence user confidence in the long-term and ongoing usage.

Further reading in this Special Issue Hasse and Kind (2019) describe the process to completely renew the adaptation platform, the Klimalotse, undertaken by the German Federal Environment Agency.

5 Conclusions

We have outlined ten guidelines for effective initiation, construction and maintenance of decision-support resources (see Box 1 for a summary). Abiding by these guidelines is not sufficient in itself, but is necessary if the final product is to be judged effective (relevant, usable, legitimate and credible). The ten guidelines fall naturally under three headings which describe the life cycle of a decision-support resource:

- At the foundational stage, they relate to the question of *who the users are*: involving practitioners in co-development and co-production, developing resources that contribute to the formation of communities of practice and ensuring that a decision-support resource is well matched to the complexity of the task and the capabilities of users.
- At the design and construction phase, the guidelines target *how the resource can achieve effectiveness*: through maintaining flexibility during the build (time dependency), innovative strategies to ensure uptake including through alignment with existing institutions and resources, identifying and working to overcome barriers to take up such as lack of capability, time and resources, and considering the potential to translate and adapt existing excellence in decision support.
- Finally, to support sustainability, the guidelines relate to *what is required to ensure ongoing relevance*: the strong need for evaluation and the virtues of comparative studies, careful documentation of changes and constant renewal.

Box 1 Ten good-practice guidelines for effective decision support in adaptation

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Foundational guidelines

Guideline 1 Practitioner involvement: Co-development and co-production are resource-intensive activities, but can deliver decision-support resources that are relevant, trusted and used by the target audience.

Further reading in this Special Issue: All papers in this Special Issue touch on co-development and co-production of decision-support resources. Leitch et al. (submitted) present a systematic start-to-end overview of the processes undertaken to ensure practitioner involvement at all points in the design, build, release and evaluation of CoastAdapt.

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Design and construction guidelines

Guideline 4 Time dependence: Ensuring relevance of adaptation decision-support resources from inception to release requires developers to be flexible, undertake meaningful and sustained stakeholder engagement and pay close attention to emerging adaptation policy and practice trends.

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Consideration of these guidelines is particularly important if developers are to meet the needs of the increasingly sophisticated and broadening adaptation practitioner communities. In the past, decision-support development has generally been ad hoc, with funding agencies recognising a gap and supporting the development of a particular adaptation decision-support resource to address that gap. Alternatively, research projects have included their development to broaden research impact. Often there has been insufficient consultation with potential users, so that take-up of the resource is below desired levels. In the future, greater and more careful attention to navigability, accessibility, legitimacy, relevance and the need for long-term support will be required to fulfil the needs of the target audience.

Although some providers of such resources have had the capacity to carry out a comprehensive evaluation of impact, this is by no means the norm. But evaluation, and continued improvement based on evaluation, is essential to ensure adaptation platforms and decision-support tools make a real and continuing difference to the effectiveness of adaptation action.

There need to be mechanisms for cross-fertilisation of ideas within and between the communities of developers and end-users. Developers of adaptation platforms and decision-support tools in different sectors or regions could learn from one another by sharing evaluation results. Applying different decision-support resources to similar problems would allow objective evaluation of relative performance, support better understanding of the utility and robustness of different approaches, and point to areas needing further development.

These messages emerging from the guidelines are not unique to decision-support resources for climate change adaptation. There is a body of literature within the broad fields of environmental research and management that focusses on the benefits of and barriers to co-production of knowledge resources, knowledge exchange and evidence-based decision-making (Reed et al. 2014; Cvitanovic et al. 2016; Djenontin and Meadow 2018).

Over time, adaptation practitioners will become ever more skilled as adaptation is mainstreamed into standard business practice. We have outlined challenges and opportunities for ensuring decision-support resources maintain their relevance and utility to meet emerging needs as this process takes place. Are today's decision-support resources an early generation, meeting the needs of adaptation practitioners on a steep learning curve and soon to be replaced? Or will maintenance and incremental improvement of today's resources allow them to evolve to better address user needs? If it is to be the latter, developers will need to pay close attention to the rapidly evolving field of adaptation and the growth of the adaptation community in its diversity and sophistication.

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