Interreg
North Sea Region
FAIR
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EUROPEAN UNION

Adaptive asset management for flood protection

A knowledge agenda for 2020 and beyond

June 2020

Summary

Asset management policy, process and practice has evolved significantly in recent decades. However, much of the knowledge relates to products, artefacts and value generation for producers. Although there are numerous useful guidance documents and best practice examples related to water management systems and flood protection infrastructure assets, there is much that is still unclear about how best to plan, deliver and manage flood protection assets in a way that these are sufficiently flexible and adaptable to cope with the significant environmental and societal changes underway. The partners in the FAIR project, situated around the North Sea Region, have both unique and commonplace challenges in managing their assets, for which new and ongoing knowledge developments and understandings are needed. Not least, they need to know when to act or when to wait for new knowledge and understandings to emerge about asset management for flood protection.

What is known is that the process and practice of asset management for flood protection needs to be continually reviewed and when necessary, adapted in response to the changes in insights about the interplay between environmental dynamics and societal needs. Effective asset management requires risk management and flexibility over the lifetime of the asset, aiming for an optimal balance between whole-life total risk, total costs and benefit-costs. To make this possible, assets need to be designed to be adaptive and flexible, using integrated system-level and strategic perspectives. As nature-based assets are invariably more flexible and multi-functional than traditional structural assets, natural and nature-based, or hybrid solutions should always be considered during the design phase using as holistic a cost-benefit analysis as possible. Inevitably this will incur increased analysis and transactional costs (in dealing with the more complex analysis and many more stakeholders involved), but this will often be offset by the increased flexibility, reliability and functionality of the assets that such approaches will bring.

These characteristics and approaches should ensure that asset management can keep pace with the demands of an increasingly complex environment, with an increasing variety and range of available data (and therefore uncertainties), conflicting stakeholders, and a society that is becoming more critical about the necessity of certain types of development.

Therefore, it is crucial to develop technical (like big-data approaches) as well as social innovations (like stakeholder alignment and citizen involvement). Only then, will we be able to provide and sustain the assets needed to address the challenges that climate change and socio-economic growth will bring.

This Knowledge Agenda considers the main challenges and knowledge needs identified in the FAIR project regarding effective asset management for flood protection, framed around a structure derived from ISO 55000:2014. Further background is provided in the project End Report. Here, five main knowledge gaps are identified, with six associated questions. The agenda will interest developers of guidance and practice for asset management for flood protection and flood risk management.

Contents

Preface

This knowledge agenda outlines the knowledge gaps in the field of adaptive asset management (AM) for flood protection (FP) infrastructure, which will help to inform research and development direction in future projects. As an output of the Interreg FAIR project, this document is collectively developed by an international consortium for the North Sea Region (NSR), from Denmark, The Netherlands, Belgium, Sweden, Germany and England and Norway.

The FAIR cascade: from (big) data to informed and inclusive decisions

The agenda presented here is structured using the AM key terms, derived from ISO 55000:2014[1] (Figure 1), which illustrates a cascade from the portfolio of assets, to the AM systems (policies, tools, plans and information systems) that give assurance that the AM activities will be delivered. The organisations should be managed in such a way that the AM systems, and therefore the actions, are implemented as optimally as possible, including facilitating adaptation. In the FAIR project another layer, engaging society at large[2], has been added to address the increasing interaction between organisations and the wider community the assets are serving.

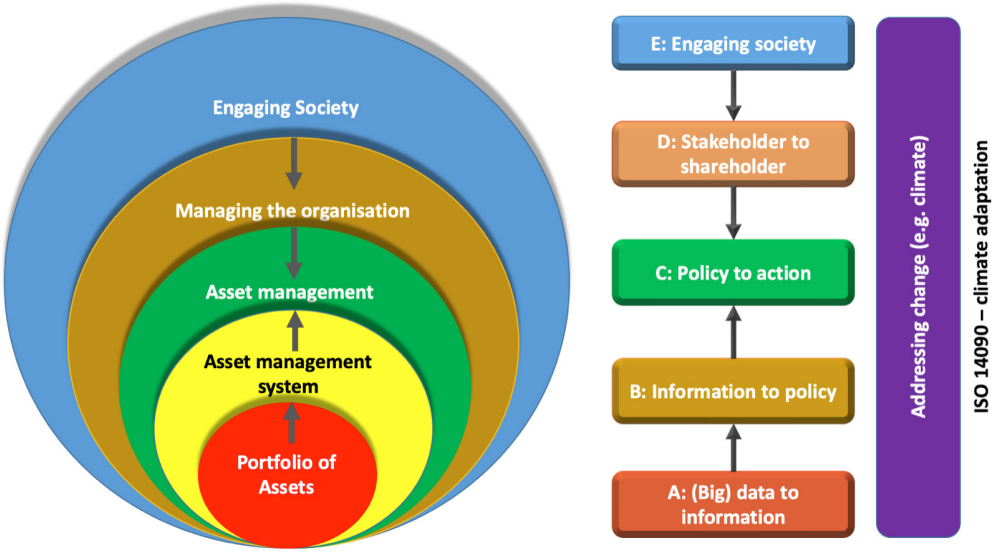


Figure 1 Left: Asset management key terms, derived from ISO 55000:2014. Right: the different categories that have been defined for this knowledge agenda.

[1] ISO, T., & SC, N. (2014). Asset management—Overview, principles and terminology.

[2] Of course, policy and decision makers, experts, shareholders and stakeholders are actually part of and embedded in 'society'. Also representative thereof.

Innovations in asset management concepts

A major innovation from the FAIR project is the bridge between the operational (focusing on day-to-day measures and activities) and strategic (corporate and long-term view) contexts for AM, using a 'tactical handshake' that ensures effective interconnections between the two loops as illustrated in the infinity shape shown in Figure 2.

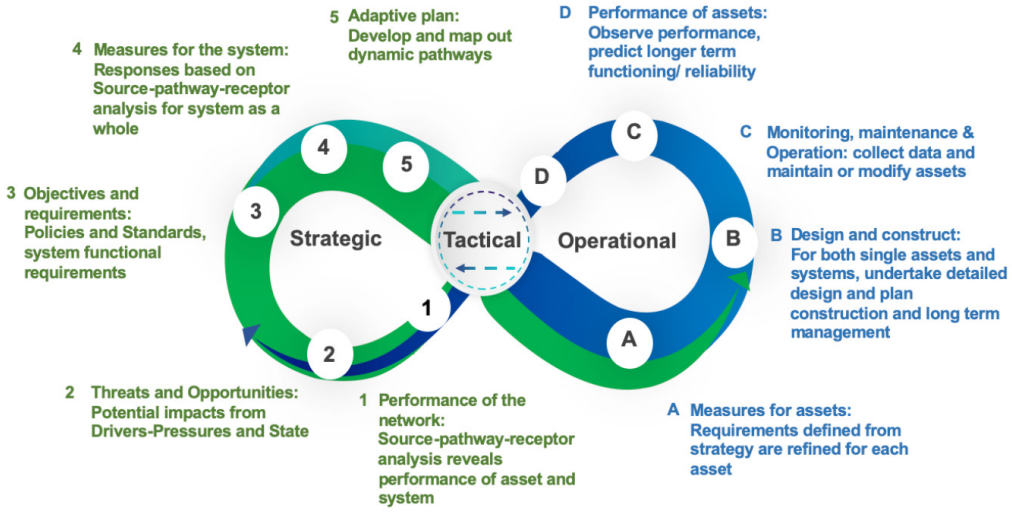


Figure 2 The three FAIR planning and decision contexts that define the framework used in the project.

Central to all aspects shown in the framework are the three main dimensions of analysis: costs, performance, and (related to the latter) risk. Embedded in each of the components shown in the framework in Figure 2 are the organisational, legal and financial aspects of each process and loop. Typically, delivery of effective AM via all of the components in Figure 2 requires strong communication between often disparate and increasingly, a widening range of players. These players include the various different 'cultures' engaged in strategic planning together with those engaged in operational processes. The traditional segregation between 'planning' and 'doing' needs to be broken down if effective AM is to be delivered. Effective AM needs to embed the ability to adapt assets and AM processes, as this will be essential for future response to change.

The FAIR project has clearly demonstrated that a life-cycle approach to AM is crucial, for which the three contexts and the organisational aspects are embedded not only at the design stage, but throughout the asset lifetime.

Assets should be designed for optimal functionality and maintained using a risk-based approach (preferably with a system-perspective), combining the probability of failure of the asset, together with the impact therefrom. Best practice AM will therefore be risk-based and include a whole-life performance[3] perspective, i.e. a lifetime risk trajectory, and a whole-life cost[4] understanding. AM is always a balance between capital expenditure and operation/ maintenance required to maintain the functional condition of the asset; i.e. delivering acceptable risk over the lifetime of the asset portfolio. Numerous frameworks are available that provide guidance towards achieving this such as that shown in Figure 3[5].

3 Literally cradle to grave – from creation of the asset to its' eventual abandonment and removal/recycle; although new ideas are moving to a cradle-to-cradle perspective based on circular economy thinking.

4 Discounted net present value (NPV) over the lifetime of operation, including both capital costs and operational/maintenance/intervention costs

5 Defra et al., (2019). Asset Performance Tools – Project Summary SC140005/S

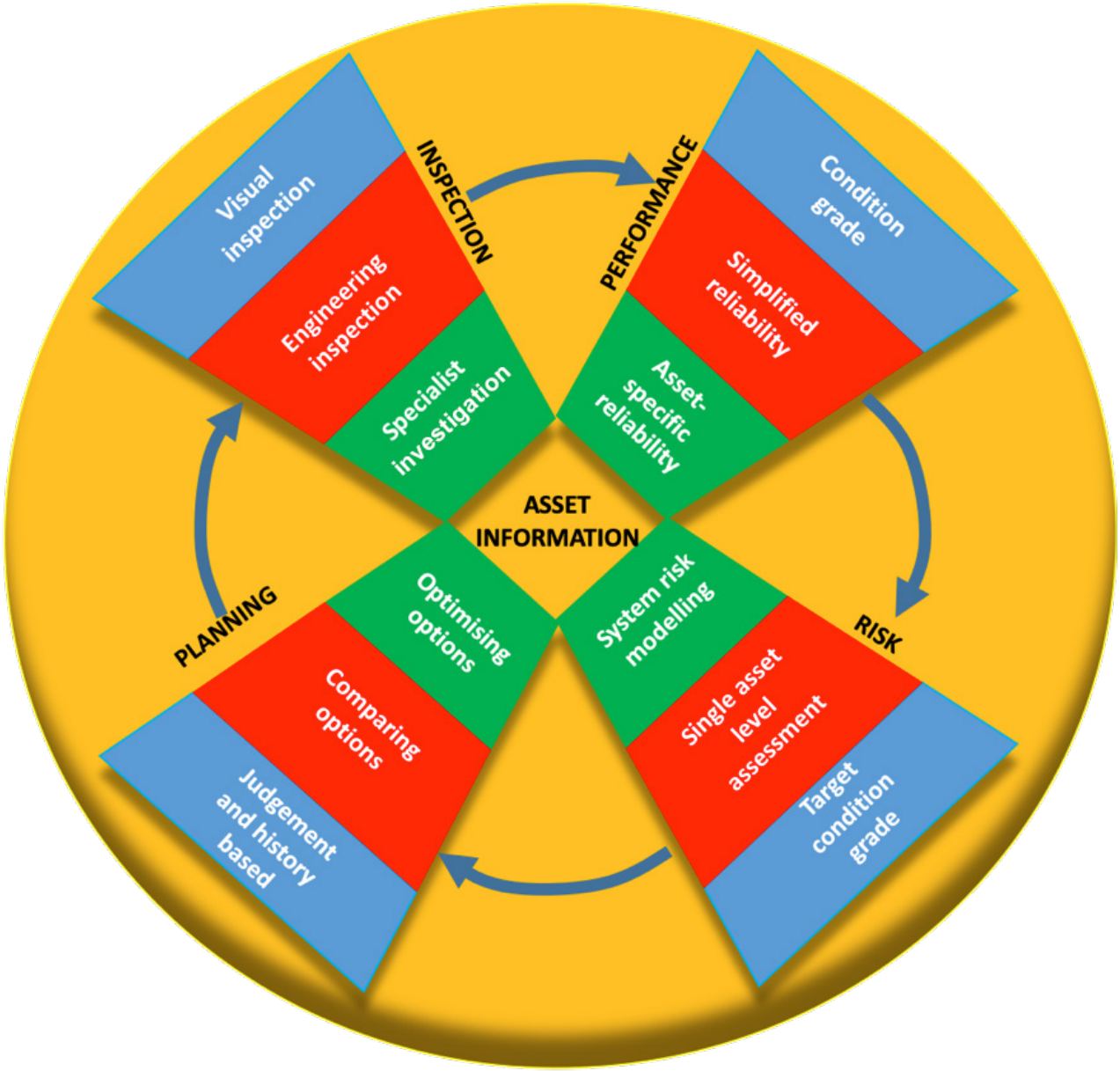


Figure 3 Example of a framework to facilitate proactive asset management (adapted from Defra et al., 20194)

This Knowledge Agenda considers the need for new or enhanced knowledge beyond 2020 that is needed in order to deliver and maintain adaptive assets and to ensure that AM processes are themselves adaptive and flexible enough to face the future challenges. This is set out in terms of five topic 'gaps' (A-E, Figure 1) and six (1-6) associated questions as summarised in Table 1. Examples from the FAIR pilot projects addressing the gaps and questions are also shown. Reference should also be made to the challenges identified in FAIR in the End Report, in Chapter 8.

Some of the topic gaps could be merged, for example, D and E in Table 1, however, these have been differentiated as they relate to the categorisation, based on ISO 55000: 2014, as shown in Figure 1. The Gaps and Questions are considered in more detail in what follows.

Table 1 Knowledge Gaps, associated Questions and FAIR pilots

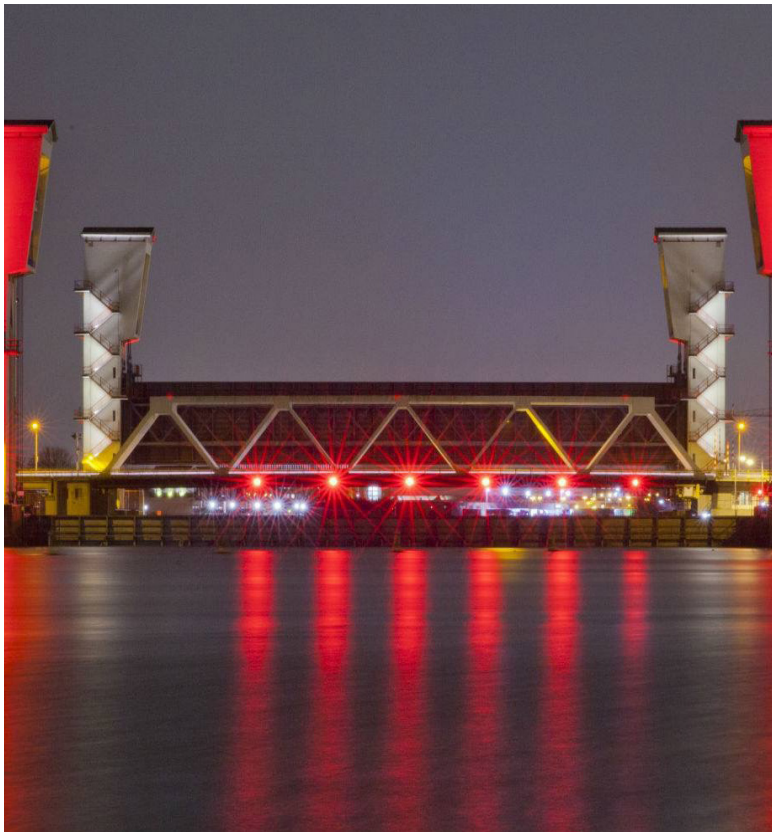
Gap	Question	Example from FAIR beneficiary pilot case studies
A. From (big) data to information	1. How can we better measure asset performance and deterioration, and therefore better understand asset dynamics over time?	FP gates Hamburg: Analysis and documenting asset maintenance processes based on collected data, using long-term experiences of the personnel, questioning of manufacturers' maintenance requirements and failures. Led to revision of data management, maintenance processes and frequency, based on computational analysis to develop risk-based operation.
	2. How can we translate Big Data on AM into good quality and valuable information for decision making?	As well as the immediate actions for FP Hamburg, in (1) above, the long-term collection of data covering all assets and aspects of performance has now been standardised to support ongoing risk based operation. Processes for turning this into useful information are being developed.
B. From uncertain information to AM policy	3. How do we take robust and adaptive decisions now with uncertain and changing information about the future?	Renewing sea dike Middelkerke using natural beach processes provides both robustness (utilising natural processes known to work) and adaptable potential in the future as knowledge increases about future conditions. Ongoing development and monitoring will ensure that as asset performance is observed, defects and shortcomings can be addressed in real time.
C. From AM policy to action	4. How do we manage our organisation(s) to efficiently translate AM policy into actions?	Helsingborg integrated city planning now brings together the range of planning processes for infrastructure, including FP, as well as other systems like transport. AM policy is therefore include across all systems and services in the development of the final city plans. However, many institutional arrangements for FP are complex and bound in such a way that these prevent or inhibit efficient operation and planning. The FAIR maturity assessment process can help organisations to understand where there may be grounds for improvement.

D. From stakeholder to shareholder	5. How do we engage relevant key stakeholders in AM as shareholders, thus creating innovative financing opportunities and (better) sharing risk?	As well as (4) above, FP Hollandsche Ijssel is now bringing together the main players in partnership to deliver an integrated cross-institution FP programme, providing shared funding, shared risks and more efficient assets. But this as yet, is a specific instance that needs to be used to ensure that such partnering becomes normal, even beyond FP, into other asset domains where this can help to share or reduce risks and pool finance.
E. Engaging Society	6. How do we engage with society in the way needed to ensure that assets are delivered and managed in the best way?	Ribe Polder is typical of FP in Denmark, as it closely involves landowners and communities of all sizes, with local dike associations operating sluices. Many citizens are at flood risk in the city due to the adjacency of the sea and also the river, which backs-up. Although analysis of the problems has so far engaged only the main institutions, direct citizen engagement will also be an essential component of developing the FP plans. There are few good examples of effective engagement as yet and more development is needed to provide standardised, or collectively agreed best means of engagement.

Gap A: From (big) data to information

This gap relates to knowledge required to determine what data has to be collected and how it needs to be interpreted such that it yields the required information both about the assets themselves and also for the socio-economic system(s) the assets serve. The Gap relates to both the operational and strategic contexts in the FAIR framework, Figure 2. In the Policy Brief it relates mainly to Recommendation #1: Align multiple planning processes within and beyond flood management.

Question 1: How can we measure asset performance and deterioration, and therefore better understand asset dynamics over time?



FAIR beneficiaries expressed the view that relatively little is known about the deterioration of various types of assets under specific conditions and pressures (for example the UK[6]). The assets should be represented by profiles of performance and costs over time that also shows the effects of interventions. Profiles should be developed for both individual assets and also groups of assets, e.g. the performance of an individual dike and the performance of the dike system, which the dike is part of. This needs to keep in tune with the understanding of societal needs and expectations of performance; i.e. the asset condition and performance profile needs to match the changing needs over the lifetime of the asset.

In addition, there are very fundamental questions about existing assets and the need to begin by ensuring that details are known, including: (i) where the assets are; (ii) what is their condition; (iii) what are the asset performance characteristics; (iv) how fragile are the assets? Figure 3 shows various forms of obtaining asset information, from simple visual inspection (that is often misleading) and unless standardised may be counter-productive, to more complex, thorough and costly processes. FAIR beneficiaries collectively have had varying experiences and approaches to data collection about assets they own or operate, in some cases leaving this to contractors (e.g. FP gates Hamburg), and including or not, standardised inspection and data management systems, as in England[7].

[6] Deterioration: "we know less than nothing"- http://evidence.environment-agency.gov.uk/FCERM/en/Default/FCRM/Project.aspx?ProjectID=48961F27-F4B6-4234-865B-EF60FB701020&PageId=a0fe6dfc-506a-452c-9bff-a7ec06b4e6b0

[7] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/779807/Flood_risk__asset_performance_tools_-_report.pdf.

Germany: Greater efficiency in operation and maintenance using past and future data and information in Hamburg

As part of FAIR, the continuing operation of the FP gates for Hamburg has been reviewed and now a more condition-oriented maintenance strategy is being implemented based on data from employee experience, the condition of the facilities, the legal framework for operation, the available resources and operational requirements defined from a risk-based assessment. As part of this, FAIR has helped in defining the best way to document existing historical data in a structured manner and set up a system to maintain direct access to all asset-related data as this continues to be gathered into the future (See information on the Dike Information System (DIS) of the FAIR Hamburg Pilot in Chapter 5 of the project End Report).

There are growing opportunities for utilisation of new sensors, digital hardware, and processing power that are resulting in increasing streams of data becoming available, as illustrated by the utilisation of a range of sensors in the dike information system in Hamburg FAIR pilot, as explained in Chapter 5 of the End Report. An integrated and shared approach for data is being taken in Hamburg between key players. But elsewhere, much of the important data may be collected and held by others, not the FP or flood risk management (FRM) operators and managers, including power suppliers, transport operators including navigation, recreational and fisheries domains. Therefore, it is important to ensure that appropriate linkages and partnerships are in place to both decide on what data are needed and also how best to share data and information across all responsible players and utilities.

Question 2: How to translate (big) data on AM into good quality and valuable information for decision making

This Question relates primarily to Recommendation #1 in the Policy Brief: Align multiple planning processes within and beyond flood management.

Question 1 considers the need for adequate data and its' acquisition, here it is the scale of data and how best to manage this that is the challenge.

FP depends on knowledge of the environmental conditions experienced by the assets as well as about the condition of the assets. Question 1 was focused on the local aspects of data needs and management for specific assets or asset groups. This information and the supporting data is set within a context of regional, national and even global data and information.

For example, climate change trends are best observed and understood on a global scale, whereas the consequences need to be understood more locally, nationally and regionally. National scale data collection provides important records of local environmental conditions, including natural processes such as weather, sea and wave conditions, as well as public interactions and institutional organisation, operation and management processes. Another major challenge is how to deal with the current assets, that are often end of technical and/or functional life. For example, asset owners need to be able to determine the short-term performance of their assets and systems. This information is also needed to prepare for challenges of the future.

For asset owners and operators in FAIR, the nationally collected data, interpretation and use to inform policy making and decisions relating to FP provides the backdrop to managing local FP and the required assets. Each FAIR beneficiary has considered the project in the context of their nationally defined climate changing predictions and implications for future impacts. For example, the relative rates of sea level rise are predicted to vary around the NSR, by up to half a metre[8] in this century. The FAIR beneficiaries needed to understand and use this information as well as locally observed data and information in planning and operating their FP assets in the project. Climate data is just a part of the overall stream of information that is available both online and from direct measurements and observations of environmental, structural, economic, social and other sources related to FP. For asset managers, understanding where the data are, availability, usability, veracity and how this can be utilised in terms of local AM is a challenge. Also, how best to set up individual data collection programmes and the processing of the data from the various sources, given that there are as yet few examples of applications to FP AM.

[8] Richards J A., Nicholls J. (2009). Impacts of climate change in coastal systems in Europe. PESETA-Coastal Systems study. European communities, JRC 55390. EUR 24130 EN. ISBN 978-92-79-14627-5.

This wealth of available (Big) data is defined as: "the information asset characterised by such a high volume, velocity and variety to require specific technology and analytical methods for its transformation into value[9]". Big Data Approaches (BDA) are becoming increasingly recognised as valuable in AM. Few FAIR beneficiaries are as yet taking advantage of access to this new wealth of data in ways that can best help with AM.

BDAs bring together historical datasets with dynamic incoming data in order to generate information and knowledge about environmental and socio-economic drivers (e.g. weather and climatic conditions), asset condition and asset performance. The increasing availability of (big) data from multiple disciplines and sources needs to be used to improve AM processes for FP. BDA can help understand the sources (of a hazard), its pathways and impacts on vulnerable receptors.

Data is coming from many different sources and disciplines, and current multi-disciplinary challenges require BDA that are fit to combine these different data sources. But BDA techniques are only just starting to get to grips with the challenges in single domains, let alone what is really required spanning utilities including power suppliers, telecommunications to FP. This integration between domains is a future challenge for BDA specialists and domain specialists[10].

The Dutch Datalab (see example below for the FAIR Lead Beneficiary, Rijkswaterstaat) and similar initiatives may be used to support the further optimisation of AM processes and decisions and will become a major component of, and benefit from, the new generation of IT creation of digital twins[11], that can better help understand the performance trajectory of an asset in real time.

The Netherlands: A datalab for managing big data

Rijkswaterstaat (part of the Dutch Ministry of Infrastructure and Water Management) continually handles a substantial amount of incoming data from different sources. Ranging from weather data from 330 weather stations, water heights, road sensors, and many more. Rijkswaterstaat launched a dedicated 'Datalab' to handle and use this data in an efficient way (e.g. with machine learning techniques). This datalab specialises in data from infrastructure assets, like bridges, storm surge barriers (e.g. Oosterscheldekering and The Maeslantkering), tunnels and sluices. It can be used to disseminate the BDA approach to other countries, that have the same challenges, to fully utilise the opportunities big data will bring on a European level.

[9] De Mauro, A., Greco, M., & Grimaldi, M. (2016). A formal definition of Big Data based on its essential features. Library Review, 65(3), 122-135.

[10] Stevens J., et al., (2020). Interlinking Bristol Based Models to Build Resilience to Climate Change. Sustainability 2020, 12, 3233; doi:10.3390 su12083233Review, 65(3), 122-135.

[11] Rotterdam is in process of creating a digital twin of the physical city. [Coumans F. (2019). 'Digital City Rotterdam' Anticipates Human Life 2.0. November/ December 2019 | GEM international. 22-24. https://www.gim-international.com/magazine/november-december-2019

Gap B: From (uncertain) information to AM policy

This gap concerns the link between information and policy in regard to AM. Information will flow mainly from the operational loop in the FAIR framework, Figure 2, via the tactical handshake to the strategic context where policy is formulated and also, when provided from an external source, translated into local AM processes. Given the apparently increasing uncertainty about the future, dealing with this is a major challenge. It relates primarily to Recommendation #3 in the Policy Brief to: Develop strategies that are flexible and assets that can be modified; and Recommendation #4: Accept that new approaches attract risk but managing, rather than avoiding, risks can lead to innovative solutions.

Question 3: How do we take robust and adaptive decisions now with uncertain and changing information about the future?

Effective AM requires risk management over the lifetime of the asset, aiming for an optimal balance between whole-life total risk, total costs and overall benefits. Even with monitoring, data and real-time systems, there are continuing and important uncertainties in planning AM.

Every FAIR beneficiary has had to consider the uncertainties about their existing assets (Question 1) and also when looking to the future. They accept the need to live with uncertainty and build it into decision making for asset planning and operation, using e.g. probabilistic modelling. An ongoing challenge is in understanding how both too much information and a lack of information can influence the policy and decision-making processes. A lack of information is self-evidently an impediment to effective decision making. But, presented with too much information, policy and decision makers can struggle with understanding, especially when faced with the varying degrees of uncertainty associated with different information. A major challenge here is for professionals and asset operators to synthesise information in such a way as to make it understandable by various stakeholders, but without losing any of the important messages. This may require presenting the uncertainties in simplistic ways, for example, using betting odds.

Belgium (Middelkerke): How to make decisions without precise data

In the FAIR project Middelkerke-Westende (Belgium), life-cycle costs (LCC) of the construction and maintenance of a dune system have been estimated. Although the investment costs were known, the maintenance cost estimates for ensuring the dunes provide functionality was uncertain, as performance depended on a variety of factors (e.g. wind, waves, temperature, and precipitation). LCC calculations were highly uncertain due to the lack of knowledge about the changes in natural systems, such as dunes, over time. This knowledge gap had to be addressed by bringing together the expertise of a number of groups of professionals and others, as the best way to understand the likely system performance over time, and improve knowledge and practice.

It is not only the uncertainties in the asset behaviour that are important for effective AM, but also the uncertainties in the socio-economic and environmental factors[12]. Climate and other changes are increasingly being understood to be relatively rapidly changing, with usually greater extremes of the natural phenomena important for FP being predicted from trends in observations[13]. It is therefore important to always take a system-approach, to look at all the assets in a system and the socio-economic conditions in which the assets are providing a service, instead of looking only at one asset or one type of driver. This raises the following important question: how can information give the required support (by reducing uncertainty) to decisions related to whole-life total risk, total costs and benefits, not only for one asset, but also for a system of assets?

The ISO 55000 series says little about uncertainty and it is necessary to look beyond the AM domain for perspectives on and means to manage uncertainty in FRM. Ideas for how BDA (see above) may help to get to grips with aspects of uncertainty are considered in detail elsewhere, for example[14]. Many scientists stress the importance of ensuring flexibility in both the approach to AM and also in the assets themselves as essential to cope with uncertainty. It is worth noting that natural and nature-based systems[15] invariably have greater flexibility than structural infrastructural assets; though flexibility is increasingly being built / designed into structural infrastructure assets. The increasing utilisation of hybrid systems, where both structural and nature-based assets are used together[16], will also bring a new set of uncertainties into AM.

More work is needed on informing and influencing how decisions may best be taken now in the light of such uncertainties and especially the appropriate place of both stake and shareholders (see Question 5 'from stakeholder to shareholder') in the process.

[12] Hino H., Hall J. W. (2017) Real Options Analysis of Adaptation to Changing Flood Risk: Structural and Nonstructural Measures. ASCE-ASME J. Risk Uncertainty Eng. Syst., Part A: Civ. Eng., 2017, 3(3): 04017005.9

[13] Krona W., Löwa P., Kundzewicz Z W. (2019). Changes in risk of extreme weather events in Europe. Environmental Science and Policy 100 (2019) 74–83.

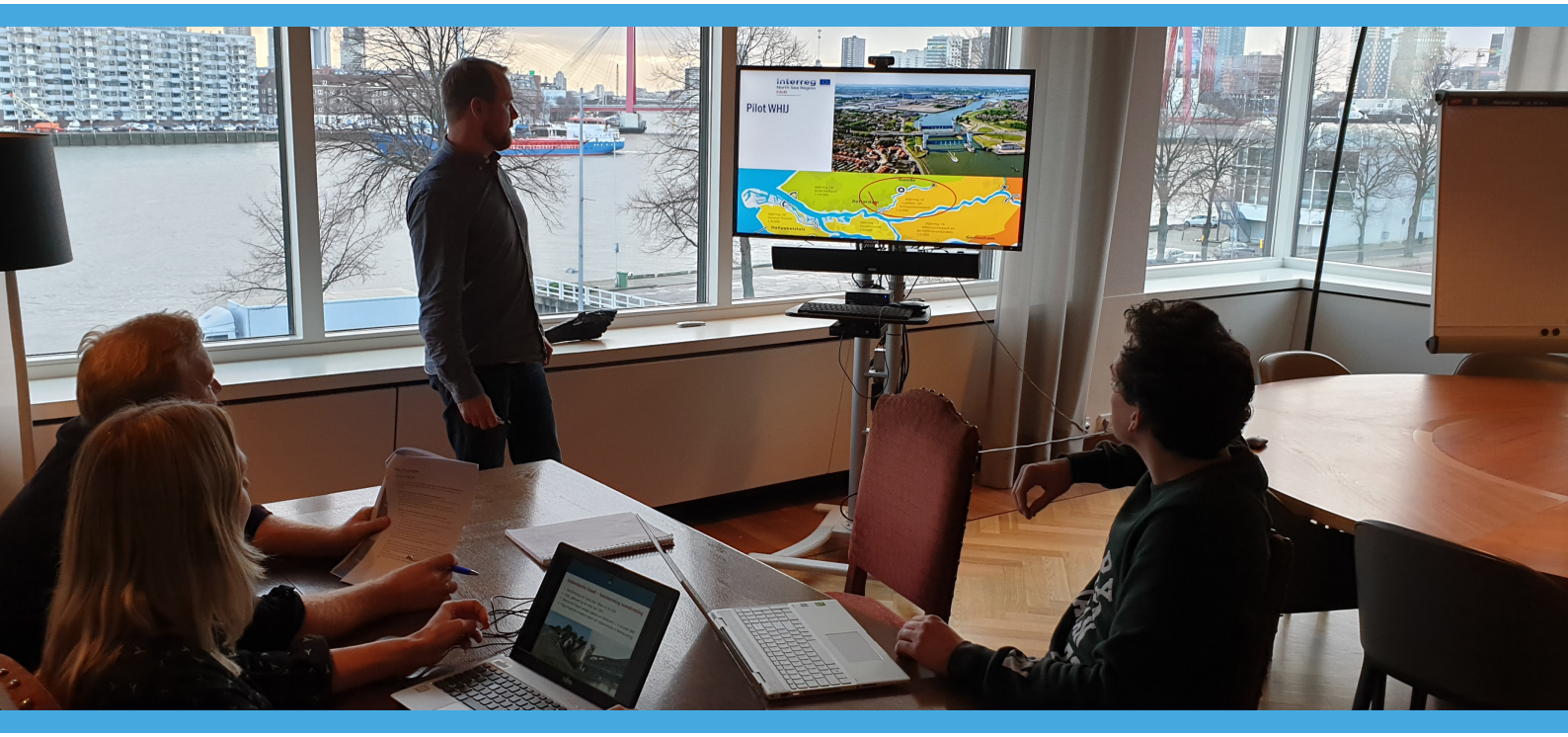
[14] Connelly E B., et al. (2017) Asset Risk Management and Resilience for Flood Control, Hydropower, and Waterways. ASCE-ASME J. Risk Uncertainty Eng. Syst., Part A: Civ. Eng., 2016, 2(4): 04016001.

[15] City of Virginia Beach, Virginia (2019). Nature-Based Coastal Flood Mitigation Strategies. CIP 7-030, PWCN-15-0014, Work Order 6C. Final Report May 16th.

[16] Kapetas L., Fenner R., (2020) Integrating blue-green and grey infrastructure through an adaptation pathways approach to surface water flooding. Phil.Trans. Roy. Soc.A. 378:20190204.

Gap C: From AM policy to action

This Gap considers the need to ensure that AM policy is translated into action and is illustrated in the FAIR framework (Figure 2) by the tactical handshake linking the strategic and operational contexts. The Question/ challenge is about managing organisations in the most effective way to deliver effective AM, and in FAIR, the beneficiaries have reviewed their own organisational processes via the Maturity Analysis as explained in Chapter 3 of the End Report. The Gap relates mainly to Recommendation #1 in the Policy Brief: Align multiple planning processes within and beyond flood management; and Recommendation #2: Link strategic planning and operational processes through a tactical handshake.



Question 4: How do we manage our organisations better to efficiently translate AM policy into actions?

In ensuring that citizens are safe and healthy from flooding and its' affects, the NSR countries have a variety of governance, regulatory, institutional and less formal arrangements in place. Each of the FAIR partner countries has a different and unique arrangement for this (Table 2.1, End Report). For some, there is a main role for central government, whereas for others, the flood risk response functions are primarily at a local level[17]. Every country also has expectations of citizens, that they take some part in ensuring their own safety.

[17] e.g. Jebens M., Sorensen C., Piontkowitz T. (2016). Danish risk management plans of the EU Floods Directive. E3S Web of Conferences e3sconf/201, DOI: 10.1051/ 6. FLOODrisk 2016 - 3rd European Conference on Flood Risk Management.7 23005 (2016) 07230

Organisational and institutional arrangements need to be configured so as to ensure that they are set up in a way that allows them to be efficient and effective and changed, adapted, or even fundamentally reformed if necessary (including termination of institutions where necessary), i.e. they need to be agile; facilitating fit-for-purpose adaptive and multi-functional AM, including for the use of nature-based measures[18]. Organisations also need to be able to respond to 'opportunity windows' when these arise, due to, e.g. a major flooding event, that will provide the means to bring about changes in policy or in the way assets are managed[19].

Cross-sectoral collaboration within and between organisations is essential, as is interdisciplinary working, as described by Rogers et al[20]. Flexibility needs to be supported by the organisations' strategy, including flexible financing mechanisms that allow for budget changes if certain adaptations are needed which were not initially considered in the budgetary processes. Traditionally, FRM organisational processes are arranged in governmental, rather than private sector organisations, although these may provide specialist services and assets[21]. Much can be learnt from how businesses can use an agile approach in informing the best ways to organise the management of flood risk assets and in delivery, which is often impaired by overly burdened internal audit or approval processes.

There are various frameworks that may be used to assess the fitness-for-purpose of the institutions involved[22] and their potential to embed adaptive approaches within their AM processes[23] as well as their organisational effectiveness[24], such as the Maturity Analysis used in FAIR (Chapter 3 in the End Report).

[18] Himmelberger H. & Yang A. (2020) Maximize Asset Management's Triple-Bottom-Line Benefits. Journal AWWA, Engineering and Construction. January 2020, Vol.112, No.1, 71-74.

[19] Hopkins K G., et al (2018). Influence of governance structure on green stormwater infrastructure investment. Environmental science & policy. 2018, Vol.84, p.124-133.

[20] Rogers B., et al. (2020) An interdisciplinary and catchment approach to enhancing urban flood resilience: a Melbourne case. Phil.Trans. Royal Soc. A. https://doi.org/10.1098/rsta.2019.0201.

[21] Radhakrishnan M., Pathirana A., Ashley R M., Gersonius B., Zevenbergen C. (2018). Flexible adaptation planning for water sensitive cities. Cities 78 (2018) 87–95.

[22] Cettner A., Ashley R M., Hedstrom A., Viklander M. (2014) Assessing receptivity for change in urban stormwater management and contexts for action. Journal of Environmental Management 146 (2014) 29-41.

[23] Westling E L., Sharp L., Scott D., Tait S J., Rychlewski M., Ashley R M. (2019). Reflexive adaptation for resilient water services: Lessons for theory and practice. Global Environmental Change 57 (2019) 101937. https://doi.org/10.1016/j.gloenvcha.2019.101937.

[24] OECD (2019), Applying the OECD Principles on Water Governance to Floods: A Checklist for Action, OECD Studies on Water, OECD Publishing, Paris, https://doi.org/10.1787/d5098392-en.

There are therefore various levels of organisational effectiveness, including managing assets, linking between the strategic and operational contexts via the tactical handshakes in the FAIR framework and also the seven dimensions of maturity used in FAIR: 1. AM decisions; 2. Information management; 3. Internal coordination; 4. External coordination; 5. Outsourcing activities; 6. Processes and roles; 7. Culture and leadership. Although FAIR has set these out, derived from beneficiary needs and experiences, they need to be further examined to evaluate their sufficiency for and with other organisations and applications to AM for FP and FRM.

Denmark (Ribe): Working together to manage increasing risks from rivers and the sea

The Danish Coastal Authority (DCA), Esbjerg Municipality , local dike associations and land owners all have a part to play in adapting the existing FP and water level control systems for Ribe, the King River and the Wadden Sea. The Municipality and DCA have primary responsibility for ensuring policy is effective, followed and implemented. The Municipality designates areas at risk of flooding and includes remediation in municipal planning and DCA provides guidance in e.g. implementing the EU Flood Directive. Although every landowner is responsible to protect their own land. Hence the FP of Ribe Polder is having to balance these many complex circumstances and interests. It is beneficial for all to strengthen both the internal and external cooperation within and beyond organisations. For example, in Esbjerg Municipality internally amongst the department responsible for managing the assets, the department responsible for the rivers and the department for climate adaption planning. Externally amongst the local dike associations, citizens, climate adaptation planning and DCA and the municipality in order to transfer knowledge and improve acceptance of possible new solutions.

Gap D: From stakeholder to shareholder

This Gap relates to the need to bring partners together in a meaningful way to ensure effective AM for FP. Although 'stakeholders' have long been considered in all aspects of public AM, there is a need to ensure that organisations with a more direct stake, e.g. as tangible economic beneficiaries; i.e. 'stakeholders' are faced with and included in the planning, funding and operation of assets. This Gap relates mainly to Policy Brief Recommendation #1: Align multiple planning processes within and beyond flood management; and Recommendation #4: Accept that new approaches attract risk but managing, rather than avoiding, risks can lead to innovative solutions.

Question 5: How do we engage relevant key stakeholders in AM as shareholders, creating innovative financing opportunities and sharing the risk?

The FAIR project has demonstrated that a system-approach is important for best practice AM. It is increasingly recognised that AM planning for FRM should focus on multi-functionality for economic efficiency[25], and to address the cross-sectoral challenges beyond flood risk that climate change brings. There is a need to have a broader, integrated appreciation of FP infrastructure (by everyone) and to capture long-term value in as many ways as possible.

This typically requires collaboration between a much wider group of stakeholders than in the past, each of whom will have a variety of different interests and business planning models. It is crucial that all relevant stakeholders are engaged and aligned during all project phases, from initiation to operation and maintenance[26]. New and more effective ways of bringing all stakeholders into the planning and management of AM and the AM processes need to be developed if the necessary projects are to come about. This is especially true for shareholders - a special type of stakeholder – engaged in the co-creation of the plan and in responsibility for delivery and maintenance and bringing innovative or alternative sources of funding.

New ways of assessing the economic benefits of using alternative FP and FRM assets have been developed[27], including for nature-based and hybrid assets, have shown that there is typically a wider range of beneficiaries and potential shareholders than had been realised previously[28]. This raises opportunities for engagement with a wider group of shareholders in planning and managing an asset, where each of them can see direct tangible economic benefits and value from doing so.

Sweden: From one responsible organisation to many shareholders in Helsingborg

The city of Helsingborg is both the asset owner and operating authority of any existing FP. But as the city area adjacent to the ocean is being redeveloped there are numerous opportunities to bring in other interested parties when planning to adapt to future flood risks, i.e. coordinated with overall city development in both space and time. However, timing of the various plans is not coordinated, so an agile FP strategy is necessary, to utilise opportunities as the plans develop. There is also a need to raise awareness amongst both citizens and internally in the Municipality about the risks from flooding. Greater awareness will provide greater commitment and buy-in (more shareholders) so that every opportunity to add FP into development as it proceeds will be taken up.

[25] Ashley R, Gersonius B, Horton B. 2020 Managing flooding: from a problem to an opportunity. Phil. Trans. R. Soc. A 378: 20190214. http://dx.doi.org/10.1098/rsta.2019.0214

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[28] Fenner R. (2017). Spatial evaluation of multiple benefits to encourage multi-functional design in blue green cities. Water 9, 953. (doi:10.3390/w9120953)

Gap E: Engaging society

The need to ensure proper and effective ways of bringing society into the way assets are planned, managed and operated for FRM is obvious, especially as in future in the NSR and similar parts of northern Europe, citizens will need to become comfortable with seeing more water in places not normally covered with water. Greater engagement with society as a whole should also ensure that AM for FP is understood to be important and appropriately financed. This Gap relates mainly to Policy Recommendation #3: Develop strategies that are flexible and assets that can be modified.

Question 6: How do we engage with society in the way needed to ensure that assets are delivered and managed in the best way?

With increasing river discharges, rising sea levels, and increasing population densities for many European countries, the impacts of flooding and the importance of FP measures (e.g. dike reinforcements) are increasing. The European population is expected to rise until at least 2044[29], which means that more people are likely to be located[30] in the most at risk (i.e. usually low-lying[31]) areas, many of whom are in the NSR, within the FAIR beneficiary countries. Citizens cannot any longer delegate all responsibility for managing flood risks to national or local organisations and need to be effectively engaged in the process of AM and planning as part of taking more responsibility.

There have always been difficulties in engaging with communities and populations about risks that are only occasionally evident, like flooding. The NSR partners, in common with other authorities, are concerned that there is no clear way to effectively engage communities, despite the guidance and research findings on the topic. Bad, or ineffective, engagement processes are known, but still used by unscrupulous authorities and experts to bias or misinform citizens in order to come to a 'preferred solution' that maximises the value to the authority, rather than to society or individuals. For example, Trowsdale et al[32] shows how 'techno-dominance' has been used in the City of Auckland, New Zealand, to dissuade a large community from taking up water re-use measures despite their already having paid for the assets. In London, the new 'supersewer' is being constructed using 19th Century technology in order to maximise the income to the private company involved, rather than to maximise societal benefits[33] or provide an integrated water system.

There are community-based attitudes and resistance to many of the changes we need to make to bring in the assets needed to cope with the future risks. For example, the increasing use of nature-based assets in urban areas is posing particular challenges, as many of these assets take up valuable land space, impacting more on land owners than for the equivalent buried assets, like pipes, or these can lead to 'gentrification' issues, displacing the poorest in communities[34].

[29] https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20190710-1

[30] Live, work, travel into or through

[31] Flooding can occur anywhere, even on tops of hills, as rain falls everywhere.

[32] Trowsdale S, Boyle K, Baker T. (2020) Politics, water management and infrastructure. Phil. Trans. R. Soc. A, 378: 20190208. http://dx.doi.org/10.1098/rsta.2019.0208

[33] Loftus & March (2019) Integrating what and for whom? Financialisation and the Thames Tideway Tunnel. Urban Studies 2019, Vol. 56(11) 2280–2296.

[34] Pearsall H., Keller J.K. (2020) Locating the green space paradox: A study of gentrification and public green space accessibility in Philadelphia, Pennsylvania. Landscape and Urban Planning Volume 195, March 2020, 103708.

In the Netherlands, well-educated and well-connected individuals have tried to stop necessary FP measures (see Box below). In view of the above, effective and mutually beneficial engagement with land owners and a wide range of communities and even individuals, is clearly even more important than in the past, especially to help people to understand the need for FRM measures and the need to use, fund and maintain these in response to climate change. Ideally communities need to be engaged from the very start to engender a sense of ownership[35] and share in the formation of plans and policies and to help with final designs and plans for operation, even assuming responsibilities, as described by Lawrence et al[36]. 'Language' used by experts needs to be tailored to the community being engaged[37], to avoid misunderstandings, and asset owners/operators failing to engage. Poor use of language inhibits public support for the new ways of delivering FP. This includes allowing some temporary 'flooding' of land spaces to protect properties and societal activities[38], and other not perceived traditional 'protect at all costs' approaches[39]. In urban areas the public co-creation of green infrastructure, addressing stormwater management such as in Philadelphia[40], necessitates public engagement as stakeholders (Question 5) to be successful. One approach to effective engagement is that of 'telling a story'; the need for such approaches is illustrated in the box below.

The Netherlands (Markermeerdijken): Opposition by famous Dutchmen to dike reinforcement program

The FAIR beneficiaries are often challenged in planning and operating FP assets by other (semi-) specialists or people with a lot of public influence. The scientific and technical aspects of AM for FP are often difficult for citizens to understand and hence there is a need to tell 'the story' from an alternative perspective. For example, the necessity for the dike reinforcement programme Markermeerdijken (The Netherlands) was challenged by a group of famous Dutchmen (scientists, actors, retired engineers). They opposed the plans for dike strengthening, especially as this would have damaged large parts of the existing dikes, which have important cultural historical value. With the increasing need for FP measures in a changing climate, and less land available due to a growing population, there is a need to find effective ways to assuage the increasing resistance from society at large.

[35] Mullenbach, L E., et al. (2019) Assessing the relationship between community engagement and perceived ownership of an urban park in Philadelphia, Journal of Leisure Research, 50:3, 201-219, DOI:10.1080/00222216.2019.1581719

[36] Lawrence J., et al., (2018). National guidance for adapting to coastal hazards and sea-level rise: Anticipating change, when and how to change pathway. Environmental Science and Policy 82 (2018) 100–107.

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[39] Rulleu B., et al., (2017) Impact of justice and solidarity variables on the acceptability of managed realignment. Climate Policy, 17:3, 361-377, DOI:10.1080/14693062.2015.1119097.

[40] Meenar M R, (2019) Integrating placemaking concepts into Green Stormwater Infrastructure design in the City of Philadelphia. ENVIRONMENTAL PRACTICE. 2019, VOL. 21, NO. 1, 4–19 https://doi.org/10.1080/14660466.2019.1568121

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Further reading

The documents relating to the FAIR project can be found on the following websites:

http://www.fairproject.org/

https://northsearegion.eu/fair/

Partners

FAIR brings together Asset Owners (facing real problems and challenges) and leading scientists (with domain expertise) to share and develop innovative solutions to the management of flood protection assets. In doing so, FAIR is the first collaboration of its kind.

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