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Issue No. 362 - Number 2/2018
Original: English

BULLETIN FAL

FACILITATION OF TRANSPORT AND TRADE IN LATIN AMERICA AND THE CARIBBEAN

Advances in the classification of inland waterways in South America

Background

The fluvial network in South America is known for having one of the highest densities and widest geographical coverages in the world but, despite this natural endowment, inland navigation still plays a rather marginal role in the transport of goods and passengers in the region.

As yet, there is no harmonized approach or set of data and information on the navigation conditions of South American waterways which would serve to realistically assess the current and potential capacity of the network for goods and passenger mobility. In addition to the practical limitations that this entails for an everyday use of inland water transport, this situation also limits planning and policymaking in terms of national and regional policies to increase the use of inland navigation in the region.

In other regions of the world, a common classification of inland waterways was instrumental in identifying the main and secondary inland waterways (IW) network and its missing links, as well as to monitor its development and evaluate the extent to which infrastructure projects enhanced the network's capacity (Jaimurzina and Wilmsmeier, 2016). A similar tool could be developed for South America, incorporating additional policy concerns, such as preoccupation with the level of logistics and mobility services and greater sustainability in providing infrastructure services.

In 2016, the Economic Commission for Latin America and the Caribbean (ECLAC) and the World Association for Waterborne Transport Infrastructure (PIANC) organized the workshop "Inland navigation and a more sustainable use of natural resources: networks, challenges, and opportunities for South America" (Rio de Janeiro, 19 October 2016).

This issue presents the advances in the classification work and the first proposal on the objectives, scope, general structure and parameters for the classification.

This issue was written by Azhar Jaimurzina, in collaboration with Philippe Rigo (Inland Navigation Commission (INCOM) of the World Association for Waterborne Transport Infrastructure (PIANC)/and University of Liège), based on the contribution of the ECLAC and PIANC experts. The authors would like to thank Calvin Creech and Fernando Torres for their contribution to the analysis of the existing inland waterway classifications in South America and Leonel Temer for substantive contributions to the text and his analysis of the ECLAC/PIANC classification survey. In addition, the inputs and comments from the following are gratefully acknowledged: Helen Brohl, Eliezé Bulhões de Carvalho, Eimair Bottega Ebeling, Andreas Dohms, Jean-Louis Mathurin, Otto Koedijk, Juan Carlos Paz, Mónica Sarache Silva and others.

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The goal of the workshop was:

- To provide a forum for initial technical meetings among South American experts, as well as international experts, on the future inland waterways classification for South America;
- To collect and analyse information and data on inland waterways characteristics, fleet (for inland, recreational and seagoing vessels), traffic intensity and other relevant factors for the development of technical and operation parameters, harmonized at the regional level; and
- To formulate an advanced draft of the technical and operation parameters for the classification and present the preliminary results of the classification for the (selected) countries of the region.

As part of this effort, the group has collected recent developments and case studies from different regions and countries on classification standards and reviewed standards and best practices in this field in order to recommend them, where appropriate, as part of the final report.

The following paragraphs summarize the results of the group's technical meetings and teleconferences on the main issues related to the classification, including:

- Context, objectives and scope of the classification;
- Overview of the existing classification systems in South America;
- First methodology proposal for the inland waterway classification for South America; and
- Pending issues and future work.

I. Context, potential benefits and objectives of the possible South American classification system for inland waterways

The first step in the preparation of the classification proposal entailed consideration of the overall situation of inland navigation in South America in order to determine the objectives and the scope of the proposed classification.

In terms of the general context, several elements set out the strategic framework for initiatives aimed at promoting the use of inland navigation in South America, including the possible regional classification of inland waterways.

First, undoubtedly, inland navigation is little used in the region, where generally, not more than 5% of all goods are transported by inland waterways nationally —and much less internationally. At the same time, the studies and planning document, such as the Fluvial Master Plan of Colombia, the Brazilian Inland Waterways Strategic Plan and the preparatory works on the draft strategic plan for inland waterways in Peru, highlight the potential for growth of inland navigation, up to five times the currently transported volume of goods in some cases (see table 1). The potential of inland navigation lies not only in greater use of the existing corridors, but also in expanding the network, as large portions of the inland waterways network in South America remain unused, and in integrating inland waterways better into the transport logistics chain. For example, in Colombia, of a total of 24,274 km of navigable waterways, only 18,225 km are actually used. In Brazil, in turn, of a fluvial network of approximately 63,000 km and 42,000 potentially navigable kilometres, only 20,000 are currently used for navigation (Jaimurzina and Wilmsmeier, 2017).

Table 1
Growth potential estimates for freight transport by inland waterways

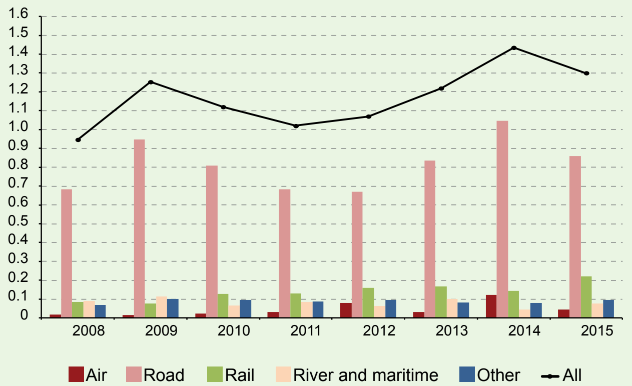
Country	Current status	Potential
Brazil	27 million tons in 2016	120 million tons in 2031
Colombia	3.4 million tons in 2015	Between 4.7 and 19.5 million tons per year, depending on the applicable scenario, with an average of 1.5 to 5 times the current freight volume transported by inland water transport.
Peru	The current cargo traffic is of the order of 3.5 million tons and about 500,000 passengers per year. Main cargo products: oil and derivatives, wood and wood products, beer and empty beer bottles. The rest includes food, cement, vehicles, machinery, steel elements, beverages, pharmaceutical products, personal care products, textiles, hardware, chemicals, electrical, construction materials, etc.	Projections for years 2023 and 2033 reach 5.0 and 7.5 million tons and more than 700,000 passengers.

Source: A. Jaimurzina and G. Wilmsmeier, "La movilidad fluvial en América del Sur: avances y tareas pendientes en materia de políticas públicas", *Natural Resources and Infrastructure series*, No. 188 (LC/TS.2017/133), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2017; on the basis of national planning documents.

Second, the infrastructure conditions are generally considered to be one of the main obstacles to greater use of inland navigation in the region. In addition to the uneven density of hydrographic systems in South America, the variability of weather conditions, significant changes in water levels and obstacles to navigation (such as sandbanks and palisades), prevent or stop transport temporarily. Furthermore, large parts of the fluvial network suffer from problems of draft limitations and predictability.

The prevailing trends in the infrastructure investment decisions in the region may explain, to a significant extent, the state of inland waterway infrastructure in the region. The persistent gap between infrastructure investment need and the amount of public and private investment observed over the last two decades (Sánchez and others, 2017) is amplified by the road-dominated modal split in transport infrastructure investment, as shown by the latest infrastructure investment data available (see figure 1). This, in practice, leaves the development of inland waterways at the margin of many transport and logistics policy interventions.

Figure 1
Latin America (selected countries): infrastructure transport investment by mode, 2008–2015
(Percentages of GDP, at current prices)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Interamerican Development Bank/Development Bank of Latin America/Economic Commission for Latin America and the Caribbean (IDB/CAF/ECLAC), INFRALATAM [online database] http://www.infralatam.info.
Note: Includes Plurinational State of Bolivia, Brazil, Colombia, Paraguay, Peru and Uruguay. Includes private and public investment.

Finally, these infrastructure-related challenges in inland navigation are not likely to be addressed by business-as-usual transport and infrastructure policies. A recent analysis by ECLAC of the advances in public planning and policies related to inland navigation, although observing significant progress in the formulation of national policies in favour of inland navigation, drew attention to several difficulties in the implementation of these polices, as well as the challenge of integrating logistics and mobility policies, among other things. An isolated and uncoordinated inland navigation policy at the national or regional level, aiming to improve the operation of some sections or rivers, is a partial approach that leads to partial solutions, not an integrated solution that meets all the mobility needs in the region.

Moving towards a new generation of integrated and sustainable transport and logistics policies, based on a co-modal approach to transport operations, entails a balanced and realistic analysis of the benefits and limitations of each mode of transport, leading to greater overall efficiency, sustainability and resilience of the entire transport system. In this sense, the development of sectoral guidelines for inland navigation policy must go hand in hand with the progress made in developing a national logistics and mobility policy, making the most of the benefits of the inland navigation, in synergy with other modes, and ending the discoordination and high dispersion among all public and private institutions involved in mobility and logistics.

Such new policies require new tools and instruments, going beyond the traditional perspectives and criteria and filling the gaps with the elements available for an integrated and sustainable approach.

As far as inland navigation is concerned, the absence of information on the current and potential capacity of inland waterways networks in South America leads to a situation in which most of the analytical and policy work on infrastructure gaps in South America either leaves out waterborne transport, focusing on the road and rail sector, or is based on very generalized assumptions, which undermines its utility in practice. The mere comparison of the levels of investment in road, rail and waterborne transport gives limited information, if there are no reliable estimates for the infrastructure investment needs for all modes of transport.

By the same token, the potential benefits of infrastructure works on a part of an inland waterway should not be considered in isolation from the state of the rest of the network. Any feasibility analysis would be enhanced if complemented by the assessment of the impact of works on the overall capacity of the network. It is significant that one of the most advanced policy and planning instruments for inland navigation in the region, the Plan Maestro Fluvial in Colombia, highlighted that one of the main difficulties for estimating investment needs is the absence of an updated and detailed inventory of the state of the river infrastructure, which could serve as a basis for estimating the costs of infrastructure works (Plan Maestro Fluvial, Colombia, 2015).

In this context, a common inland waterways classification could provide a tool for assessing the status of the existing waterways and their current and potential capacity to integrate into the national and regional logistics chains, helping to implement a more sustainable logistics system. It would help to identify the main and secondary inland waterway network and its missing links as well as to monitor its development and evaluate to what extent the infrastructure projects implemented enhanced the capacity of the network.

The exchanges on the benefits of the classification, helped to identify various possible positive impacts of the classification for both the public and private sectors. As a first step in this discussion, ECLAC and PIANC carried out a survey of experts on waterborne transport between July 2016 and October 2017, which resulted in the ranking of the possible objectives for the classification, presented in table 2.

The following discussions in the group have emphasized the link between the classification and financing, both public and private, through identification of viable infrastructure projects. They have also facilitated a more comprehensive view of the impact of the individual projects on the overall capacity of the waterway network and identification of the specific interventions which would result in a qualitative leap in the inland navigation operations.

The statements also highlighted that the classification could offer a concrete way of incorporating sustainability concerns into the management and development of inland waterways, preserving and capitalizing upon the environmental and other benefits of inland navigation. Indeed, although inland navigation offers substantial advantages in terms of sustainability, especially environmental sustainability, these advantages are not automatic and require accompanying public policies and specific measures to promote innovation, investments and a sound regulatory framework for inland shipping operations.

Inland navigation is generally considered to emit less carbon dioxide per ton-km than other modes of transport. However, with respect to other emissions, such as particulate matter and sulfur oxides, inland navigation offers few or no advantages, because regulations on road transport emissions and innovation have advanced more rapidly that regulation on emissions of inland navigation and innovation in the fluvial sector. For example, trucks that meet the Euro VI standard have a better performance per ton-km than inland watercraft in terms of emission of particulate matter and sulfur oxides (Kampfer and others, 2012). This can be explained by the fact that in the case of inland barges, the average engine load is 40%, resulting in a substantially longer life cycle, up to 35 years (European Commission's PROMINENT Project[1]), whereas the average life cycle of trucks is 5 years.

Table 2
The main applications/potential applications of a common South American inland waterway classification

Ranking of the classification objectives
1. Supporting inland waterways policies and projects in infrastructure development: planning, monitoring and identifying missing links and bottlenecks that should be prioritized
2. Planning of regional integration projects
3. Increasing safety and ease of navigation by ensuring the orderly and efficient control and maintenance of waterways
4. To serve as a basis for investment decisions and cost estimates by governments and the shipping and transport industry
5. Achieving a more sustainable use of inland waterways (and transport in general)
6. Making information available as a guarantee for users that minimum dimensions will be respected
7. Use of new technologies (e.g. river information services (RIS), automatic identification systems (AIS))
8. Vessel design/naval improvements
9. Identifying inland water transport competitiveness by laying down maximum vessel sizes, affecting navigation and transport costs
10. Facilitating access to financing of infrastructure projects
11. Providing a common language for different stakeholders

Source: World Association for Waterborne Transport Infrastructure (PIANC) and Economic Commission for Latin America and the Caribbean (ECLAC).

Based on the results of the survey and further exchanges, the group identified potential benefits of a common inland navigation classification system for South America (see table 3).

[1] See European Commission, PROMINENT Project [online] http://www.prominent-iwt.eu/.

Table 3
Benefits of a common classification system from the public policy and user perspectives

From the public policy perspective	From the private sector/user perspective
Measuring and monitoring the state of inland waterways infrastructure.	Accessing information on the navigation conditions
Providing an inland waterways inventory which facilitates intermodal integration	Providing ease of navigation
Providing a basis for estimating the investment gap, maintenance needs and impact of new investments	Providing security of navigation
Facilitating access to financing	Adopting standards for river information services (RIS)
Incorporating sustainability concerns	Enabling better conditions for industrial development (naval construction)
Providing a common basis for bilateral and regional agreements	Providing parameters for estimating costs and benefits of investments in fleet, new infrastructure and maintenance

Source: World Association for Waterborne Transport Infrastructure/Economic Commission for Latin America and the Caribbean (PIANC/ECLAC), Working group on the development of a proposal of inland waterway classification for South America, 2018.

II. Possible classification parameters and existing inland waterways classifications in South America

The ECLAC/PIANC "Position paper. Inland waterways classification for South America: core concepts and initial proposals" concluded that, while the existing international classification, i.e. the UNECE/CEMT Classification for European inland waterways, demonstrated practical impact and various uses of inland waterways classification for infrastructure development and for defining the basic regulatory framework for inland navigation, its technical and operational criteria for classification did not correspond to the characteristics of the inland waterways in South America (Jaimurzina and others, 2016).

Bearing in mind these conclusions, as well as the discussion on the benefits of the future South American classification of inland waterways, the group proceeded to analyse the possible classification criteria specific to the region.

The abovementioned ECLAC/PIANC survey was also used to gather recommendations in terms of the most significant classification parameters for South America, which resulted in a ranking of classification parameters, as shown in table 4.

To complement this analysis, the group also gathered information about the existing inland waterway classifications at the national level. As noted earlier, with the exception of Brazil and Colombia, the South American countries had not developed a clear and practical inland waterway classification. The main characteristics and lessons learned from these national experiences are summarized below.

Table 4
Ranking of proposed parameters for inland waterway classification

Waterway depth (minimum and average, per month)
Navigability (level of difficulty)
Guaranteed secure navigability all year round (percentage of time: 50%, 75%, 90%, 99%)
Vessel type (barge, convoy, seagoing), tonnage and dimensions (draft, beam, length)
Navigation obstacles/constraints (shallow passage, etc.)
Availability (or not) of waterway signs and markings, aids to navigation facilities, and river information services (RIS)
Guaranteed day and night navigation (with suitable traffic aids): 24 hours/day
Tides/water level information services
Air clearance (bridge)
Availability of ports and terminal facilities with a multimodal platform
Existence of flow control infrastructure, such as navigation weir and navigation locks, that limits ship sizes
Local wind, current and wave characteristics
Facilities for environment-friendly navigation
Traffic volume (tons or passengers) and number of vessels per day
Availability of vessel support or assistance services

Source: World Association for Waterborne Transport Infrastructure (PIANC) and Economic Commission for Latin America and the Caribbean (ECLAC).

A. Inland waterways classification in Brazil[2]

The Brazilian Waterway Classification System was developed by the Brazilian National Department of Transportation Infrastructure (DNIT), and was codified on 13 September 2016 in Administrative Bulletin No 172, Portaria No 1.635.

[2] The summary of the Brazilian system is based on a technical report, prepared by Calvin Creech, U.S. Army Corps of Engineers, in close consultations with the national experts in Brazil.

This Codified Policy was based on "studies and plans already published by Agencies and Organizations in the Waterway Sector and more than 40 years of surveys about the main rivers that are currently in the Federal System (SFV)". The Brazilian Waterway classification system defines the design vessel dimensions for length and width, and includes a parameter in the system for minimum operational waterway depth (not vessel draft).

The classification system is presented in table 5 and 6.

Table 5
Classes in the Brazilian System of Design Vessels

Class	Maximum width (B) (*metres*)	Length (L) (*metres*)
I	48	280
II	33	210
III	25	210
IV	23	210
V	16	210
VI	16	120
VII	12	140
VIII	12	80
IX	12	50

Source: National Department of Transportation Infrastructure, *Boletim Administrativo*, No. 172, Brasilia, 2016.

Table 6
Sub-Classes (Categories) in the Brazilian System based on Waterway Depth

Category	Minimum Opertional Depth (P) (*metres*)
Special	P > 3.50
A	3.50
B	3.00
C	2.50
D	2.00
E	1.50
F	1.00

Source: National Department of Transportation Infrastructure, *Boletim Administrativo*, No. 172, Brasilia, 2016.

The Brazilian system also addresses some of the issues related to the inland waterway design criteria. For instance, the width of the waterway (B_{ms}) itself (for straight reaches) is based on the following formulas:

- One-lane traffic the Waterway Width (W): B_{ms} = 2.2 x Maximum Vessel Width (B)
- Two-lane traffic the Waterway Width (W): B_{ms}= 4.4 x Maximum Vessel Width (B)

Additional waterway widths for curve sections are not codified in the 2016 Brazilian Administrative Bulletin No. 172, Portaria No 1.635, but in practice, the following formula is generally used for additional widths in curves:

$$B_{mc} = Bms + \frac{L^2}{2R}$$

where,

B_{mx} = Channel Width in a curve

B_{ms} = Channel Width in a straight reach

L = Length of the design vessel or convoy

R = Radius of the curve

Additional design elements of the Brazilian system include:

- A curve in the waterway is defined when the radius is less than 10 x the tow length (L)
- A curve cannot have a radius less than 4 x the tow length
- Distances between curves must be a minimum of 5 x the tow length
- Dredging sites require minimum side slopes of 1:8 for alluvial channels
- Rock excavation sites require minimum side slopes of 1:1

The classification has been applied by DNIT on various waterways since the adoption of the classification. For example, in Brazilian Administrative Bulletin No. 021 (30 January 2017) the Madeira River was established as a Class II-A Waterway between Porto Velho and the confluence with the Amazon River. In the same Bulletin the Paraná River was established as a Class V-A Waterway between Foz do Iguaçu, PR and São Simaõ, GO; and is established as a class VII-A between the confluence with the Rio Tietê and the Três Irmãos lock. In both river systems, it is noted that these specifications do not apply for the waterways during high flows (presumably to allow for larger convoy configurations).

B. Inland waterways classification in Colombia[3]

There have been two attempts to classify the waterways in Colombia: by the National Planning Department (DNP) and Ministry of Transport in 1994 and by the Ministry of Transport in 2000.

The classification of 1994 categorizes the national fluvial network in "primary" or "secondary", depending if the waterway has an important flow of cargo or is mainly dedicated to regional activities (to take also into account the social benefit of a waterway). It should be highlighted that already from these first classification efforts, the need of a social component was found necessary when classifying a waterway in a Latin American country, instead of making a classification based purely on economic variables or volumes of transported cargo.

[3] The summary of the Colombian system is based on a technical report, prepared by Fernando Toro, TORGUN, in close consultations with the national experts in Colombia.

The Manual of Navigable Rivers published by the Ministry of Transport in 2000 is the second attempt of classification. Despite the enormous efforts of this document to formalize and summarize the restrictions in navigation in the waterways of the country, the information presented in schematic maps and tables is not precise. The waterways are categorized in this document in "major" (which can be "permanent" of "transitory" depending if the river is navigable the whole year or is interrupted in the summer periods) and "minor" navigation. Furthermore, this classification is the result of extrapolating to waterways the classification of "major" and "minor" vessels made by the Ministry of Transport in 1999 for the Colombian fleet. "Major vessels" are those with a DWT higher or equal to 25 Ton; and therefore, "major waterways" are those with capacity to allow the traffic of "major vessels".

These classifications have been used consistently up to nowadays, including the most recent study on this topic, the Fluvial Master Plan of 2015 (*Plan Maestro Fluvial de Colombia 2015*, PMF). However, these classifications do not follow a rigorous method with objective parameters used in the analysis, ending up in a classification highly dependent on qualitative interpretations, rather than a formal classification using quantifiable criteria.

The concerns and limitations of the existent classifications are already recognized by the fluvial sector, which would embrace a new more formal classification knowing the benefits this could bring along with a stronger and clearer framework for them to perform their professional activities.

The information available at present for a new classification of the waterways in the country is incomplete, outdated and spread in several sources. A first step forward would be the collection of data about the existent fleet and the navigation conditions at present. Although it is not strictly necessary to know all this information to propose a classification system, it is important and it would be useful to know what type of vessels (and quantity) are used in Colombia at present and know about the status of the waterways at present. Besides, this information will be necessary in the future to classify the waterways in all the basins of the country. The Fluvial Master Plan of 2015 also stresses that a detailed and complete update of the information about the Colombian fluvial fleet and the status of the waterways is highly recommended. The way this information is collected and sorted should be done in such a way that it can also be used in the future for the implementation of a river information service (RIS) in Colombia, non-existent today.

C. Other inland waterways classifications in South America

Although there were no other examples of national classification in South America identified by the group, two additional elements were highlighted.

Firstly, several South American countries have a definition of a "waterway network" according to its economic capacity for the transport of goods or passengers:

- Brazil refers to the "economically viable" network, which includes inland waterways with cargo flows (existing or potential) exceeding 50,000 tons per year (highlighting the need to develop a classification system for waterways also to improve the information available about its fluvial system).
- Peru presents a concept of the "main commercial waterway network", which includes rivers that are navigable during most of the year, which, given the limited road connections, constitute the guiding axis of development, economy and integration of the Peruvian Amazon, as well as the only means of mass communication.
- As mentioned before, Colombia makes a distinction between waterways related to cargo transport (transportation of large volumes over long distances and oriented to exports, imports and commercial exchange among regions of the city system) and the transport of passengers and goods (connection between isolated towns and regions). In both categories, Colombia determines the appropriate routes for "major navigation" or "minor navigation".

At the same time, there is an established practice in South America of guaranteeing a minimum operational depth on the main stretches of the most important waterways. This is done both at the national level and on the international watercourses, such as Hidrovía Paraguay Paraná, Rio Magdalena or part of the Amazonian network in Peru.

D. Conclusions

The analysis of the existing classification systems led to the following conclusions.

At the present the Brazilian system represents the most advanced inland waterways classification in South America. At the same time, the Brazilian system focuses mainly on the physical dimensions of the waterway and horizontal dimensions of the vessels and does not incorporate the quality of service to navigation.

While there are some basic distinctions based on the existing commercial traffic on the waterways, the dominant practice in the region, in terms of main characteristic of inland waterways and their physical dimensions relevant for navigation, is the guaranteed minimum water depth of the navigational channel.

III. Proposal on the basic structure and parameters for inland waterways classification in South America

The technical discussions and analysis of the existing classification systems and practice in South America, summarized above, resulted in the following proposals, regarding the objectives and general principles, the basic structure and the classification parameters.

A. The main objective of the common regional classification of South American inland waterways

The four main objectives of a common regional classification of South American inland waterways, should be:

(i) Supporting inland waterways and, more generally, transport policies and projects in Infrastructure development and operation, including planning, monitoring and identifying missing links and bottlenecks that should be prioritized;

(ii) Increasing safety and ease of navigation by ensuring the orderly and efficient control and maintenance of waterways;

(iii) Facilitating the planning of regional integration projects;

(iv) Achieving a more sustainable use of inland waterways (and transport in general).

It is, therefore, deemed important that the classification go beyond the basic infrastructure parameters, offering means to incorporate the perspective of the quality of services to navigation, specifying the parameters to be complied with when constructing new or modernizing existing inland waterways. The underlying objective is to contribute to the sustainable development of the entire region, that is, to establish an integrated, co-modal and sustainable transport network at the national and regional level.

In addition, as the end users of the classification would be the decision- and policy makers in both public and private sector, to the maximum extent possible and in a pragmatic way, the classification should offer both the elements needed to estimate the extent of the public infrastructure investments (to upgrade or maintain the level of services), and a minimum information on the operational requirements for the benefit of the private sector and other users of inland navigation.

The classification should not only be based on the specific conditions of local navigable waterways but be of the broadest possible scope, i.e. incorporating waterways of diverse characteristics, given the important social and economic function of some sections at the local level, and diversity of navigation conditions related to hydrography and climate. To serve the purpose of forming a national and regional vision of fluvial mobility, the classification should take into account the potential and the great diversity and heterogeneity of the flows of goods and people, not only focusing on the large international flows, but also on small flows within the region, where millions of people occupy the fluvial mode in the absence or limitations of other types of terrestrial connectivity.

In this sense, a South American classification of navigable waterways should devote the same attention to regional corridors and local development corridors, and serve to harmonize and adjust technical and operational parameters. This could aim at improving the visibility, efficiency, safety and sustainability of the fluvial infrastructure and facilitating access to financing. This also entails the need for a flexible system which could account for the dispersion of data among various institutions and geographical levels and the lack of information on the significant informal market and activity in inland navigation which is not captured by the official sources.

Building on the elements specified above, the current methodological proposal is based on the **following basic principles**:

- The classification will take into account both the physical dimensions of the waterways (and, optionally, the vessels) and the level of services offered to the navigation. In this sense, the classification will go in line with the concept of the "infrastructure services", and will not be restricted to the purely physical characteristics of the infrastructure, also accounting for the flow of services that a waterway provides.
- The classification will include, in one form or another, some elements on the sustainability (environmental, but also social, economic and institutional) in the development and use of inland waterways.
- For practical purposes, the current classification proposal will serve to classify the so-called "shallow waters", reserving another class to deep-sea navigation, given the great difference in the parameters and exigencies of services, as well as the existing national and regional regulations dealing with the deep-sea navigation.
- The classification will apply to both freight and passenger transport on inland waterways.

B. The general structure of the classification

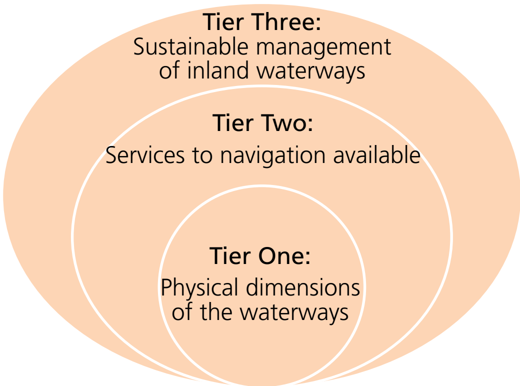
In light of the objectives, general requirements and the technical analysis above, it is proposed that the classification of inland waterways be based on the three sets of criteria (three-tier classification, as set out in figure 2):

(i) Physical dimensions of the waterway, which will define the class of the waterway;

(ii) The level of services to navigation available on the waterway, which will define the category of the waterways;

(iii) The regulatory and governance regimes, which will offer an overview of the sustainability in the management of the waterway.

Figure 2
Basic structure of the inland waterways classification for South America



Source: World Association for Waterborne Transport Infrastructure/Economic Commission for Latin America and the Caribbean (PIANC/ECLAC), group on the development of a proposal of inland waterway classification for South America, 2018.

In the first two tiers, specific criteria will define the divisions in classes and categories. There will be no relationship between classes in Tier One and categories in Tier Two, as emphasized by the different nomenclature applied.

A vessel or convoy normally operating on waterways of one class could be used on waterways belonging to a higher (better) class or category without restriction as to the parameters covered by the classification.

In the third tier, instead of technical criteria, some guidelines to assess the progress or challenges in the addressing the sustainability issues in the management of waterways will be offered.

(i) Tier one: classes of inland waterways

Tier One shall divide inland waterways in classes and sub-classes, according to the physical dimensions of the waterway.

The primary parameter for the classification shall be the **guaranteed minimum water depth** of the navigation channel, as per table 7.

The classification in Tier One can be supplemented by sub-classes, according to the maximum dimensions of the fleet (variant a, as set out in table 8) or, if the information on the fleet is not available, by the minimum width and air clearance of the waterway (variant b, as set out in table 9).[4]

For a waterway to be classified in a specific class or sub-class, its specified minimum water depth shall be available at all times, with no more than 30 days of impacted service.

[4] It is quite conceivable that not in all cases the fleet dimensions are known and, in this case, the estimates of the waterway dimensions are useful to a certain extent. However, if the fleet dimensions are known, the necessary waterway dimensions can be derived from design guidelines, the other way around not so easily. So, the fleet dimensions are to be preferred over the waterway dimensions.

If further information is available, the exact number of days with impacted services can be indicated as follows:

***: Less than 10 days of impacted service
** : Less than 20 days of impacted service
* : Less than 30 days of impacted service

(ii) Tier two: categories of inland waterways

Complementing the division in classes, the waterways will be divided in categories according to the level of services, as per the matrix, contained in table 10.

The minimum requirements for a waterway to qualify for each of the parameters, shall be specified.

(iii) Tier three: regulatory and management regime

Complementing the first two tiers, tier three will offer the possibility to assess the comprehensiveness of the regulatory and management regime in terms of the sustainable management of the waterways, i.e. a balanced consideration of the economic, social, environmental and institutional dimensions. table 11 introduces the basis for Tier Three.

Table 7
Classes Tier 1

Class	Minimum water depth (*in metres*)
VI	3.5
V	3.0
IV	2.5
III	2.0
II	1.5
I	1.0
N/A	Data not available

Source: World Association for Waterborne Transport Infrastructure/Economic Commission for Latin America and the Caribbean (PIANC/ECLAC), group on the development of a proposal of inland waterway classification for South America, 2018.

Table 8
Subclasses Tier One: Variant a: maximum fleet dimensions[a]

Class	Maximum Width (B), (*in metres*)	Maximum Length (L), (*in metres*)
a9	≥48[b]	≥280[b]
a8	33	210
a7	25	210
a6	23	210
a5	16	210
a4	16	120
a3	12	140
a2	12	80
a1	12	50

Source: World Association for Waterborne Transport Infrastructure/Economic Commission for Latin America and the Caribbean (PIANC/ECLAC), group on the development of a proposal of inland waterway classification for South America, 2018.
[a] Maximum fleet dimensions are defined as the maximum width and length of the vessels, which can be operated on the waterways.
[b] Vessels with larger dimensions can be found in some of the region's inland waterways. Yet, subclasses in this methodological proposal shall be revised and expanded in the future.

Table 9
Subclasses Tier One: Variant b: minimum waterway dimensions

Sub-class	Minimum width of the navigation Channel *(metres)*	Minimum width in case of locks *(metres)*	Air clearance (height under the bridge) *(metres)*
b6	100	40	15
b5	80	35	12
b4	60	25	9
b3	50	16	7
b2	40	12	5
b1	30	6	3

Source: World Association for Waterborne Transport Infrastructure/Economic Commission for Latin America and the Caribbean (PIANC/ECLAC), group on the development of a proposal of inland waterway classification for South America, 2018.

Table 10
Draft classification matrix according to the level of service

	Advanced		Intermediate			Basic			
Category	Navigation 365/365	Navigation 24/7	River information services	Automatic identification systems	Intermodal connections/ terminal transshipments	Surveillance and security facilities	Physical aids to navigation	Navigational charts	Hydrometric surveys and network
A	If both		x	x	x	x	x	x	x
B	If one of them		x	x	x	x	x	x	x
C			If all three			x	x	x	x
D			If two of them			x	x	x	x
E			If one of them			x	x	x	x
F						If less than the 4 four basic services			
X	N/A	N/A	N/A	N/A	N/A	N/A			

Source: World Association for Waterborne Transport Infrastructure/Economic Commission for Latin America and the Caribbean (PIANC/ECLAC), group on the development of a proposal of inland waterway classification for South America, 2018.
N/A: information not available.

Table 11
Regulatory and management regime

Regulatory and management regime	Regional integration	Environmental aspects	Social dimension	Economic and financial dimension	Institutional dimension
	Use of regional or international standards as part of the regulatory regime or river basin-approach	Existence of rules and practices to deal with the environmental implications of the waterway development	Existence of rules and practices to deal with the social implications of the waterway development	Existence of investment plans and financing schemes for the development of the waterway	Existence of dedicated institutions in charge of the waterway's development and effective division of responsibilities and coordination mechanisms
A	If all five				
B	If four out of five				
C	If three out of five				
D	If two out of five				
E	If one out of five				
X	Information not available				

Source: World Association for Waterborne Transport Infrastructure/Economic Commission for Latin America and the Caribbean (PIANC/ECLAC), group on the development of a proposal of inland waterway classification for South America, 2018.

Relevant supporting documentations will be used to confirm the comprehensiveness of the regulatory and management regime.

C. Application of the classification

The resulting classification would classify a waterway with maximum capacity, the highest level of service and the best management system as: VI a9-A-A or VI b6-A-A.

A waterway with maximum guaranteed depth but limitations in the beam and length of the vessels, the intermediate level of service and the limited management system would be classified as: VI a3 (or b3)-D-C.

The system will allow for a gradual or partial classification, based on the available information and identifying the data to be collected. Where information is not available, the classification could be of the type: V (x)-B-X.

IV. Pending issues and the next steps

The first classification proposal offers several benefits in line with the objectives and scope of the classification.

First, the first two tiers of the classification, which capture both the physical capacity of the waterways (measured by its dimensions or maximum dimensions of the fleet) and the level of services, offer both the elements needed to estimate the extent of the public or public infrastructure investments (to upgrade or maintain the level of services), and minimum information on the operational requirements for the benefit of the private sector and other users of inland navigation. At the same time, the proposed classification effectively decouples the physical capacity of the waterway from the level of service, allowing the smaller waterways to receive a separate higher rating if the quality of services is ensured.

Secondly, Tier Three, if operationalized, can pave a way towards incorporating sustainability and governance concerns in the classification, enhancing the quality of the management of the waterways.

Third, the system offers a strong degree of flexibility, can accommodate additional criteria in all tiers and allows partial and gradual application. It also offers synergies and potential for the incorporation of the technical standards related to the services provided to the navigation.

Finally, through its comprehensive approach, the resulting full classification should identify the weakest links and elements in each waterway and in the network, as a whole.

At the same time, there are numerous pending issues to address before obtaining a functional classification methodology:

- The need to confirm how the classification deals with the issues of availability and/or reliability and of how the minimum capacity is guaranteed in terms of periods of time or percentage of navigation period, or in terms of the waterway's coverage (navigable portion of the waterways, in width and length).
- The need to confirm the exact values for the intervals based on a set of the representative values for South American inland navigation. For instance, the exact number of classes according to the dimensions of vessels should be defined based on the pragmatic analysis of the value added of shorter/larger intervals between dividing values from the perspective of shipping (practices and needs) and infrastructure works. The concept of "special conditions" could be used to offer a bit more of flexibility in using classes.
- Depending on the results of the trial operations, one of the two variants in defining sub-classes could be eliminated in favour of the other. There is a strong preference for subclass variant a (vessel dimensions) as this is the usual reference for many actors, including shipping companies, ship owners, ship builders, waterway builders and managers and those responsible for navigation including the pilots.
- There is a need to clarify the key concepts used. The final document should include a glossary with the definition of the main terms used, such as class and category. If possible, it should also contain guidelines, as to guide countries in its application and corresponding decision-making on inland waterways infrastructure development and maintenance.
- To complete the minimum service requirements for the categories in tier two.

The current proposal will undergo several technical discussions to confirm the basic structure and the exact classification criteria. Then, a series of pilot applications will be performed in order to arrive at a final methodological proposal.

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