Requirements validation survey for Digital twin of Port of Twente

The purpose of this survey is to validate and prioritize the requirements for the digital Twin under development for the Port of Twente. The requirements have been captured by analyzing interviews with 9 stakeholders. This survey is expected to take approximately 10 minutes.

In the software development process, requirements validation and prioritization play an important role. Requirements validation is used to determine the correct requirements, avoiding inconsistencies, incompleteness, and inaccuracies. Requirements prioritization is the process of prioritizing requirements for software and is an important step in making critical decisions to increase the value of the system.

Your responses are very important and will have a significant impact on the development process of this digital twin. I sincerely appreciate your participation to this survey.

* Indicates required question

1. Email *

2. Name of company *

For each requirement, you will be asked to choose how important the requirement is to you on a scale of 1 to 4.

1 is equivalent to the system does "Not need to have" that requirement
2 is equivalent to the system "Could have" that requirement
3 is equivalent to the system "Should have" that requirement
4 is equivalent to the system "Must have" that requirement

We first start with Functional requirements.

1. Environmental Information

1.1.0:

Water information

3. ***1.1.1:*** *

System displays real-time water level, depth and flow

- Such as at Ijssel River, Twente Canal, around locks and bridges

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

4. ***1.1.2:*** *

System alerts users when water level is lower/higher than certain level

- Such as When the IJssel River water level is lower than possible water pumping water level, it alerts users

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

5. ***1.1.3:*** *

System calculates and displays predicted water level/depth for next several weeks

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

6. ***1.1.4:*** *

System alerts users when predicted water level/depth is lower/higher than certain level

- Such as When the predicted IJssel River water level is lower than possible water pumping water level, it alerts users

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

7. ***1.1.5:*** *

System allows users to set specific conditions to activate alarm

- Such as, Set water level lower than 8 meter as a condition to activate alarm function

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

8. ***1.1.6:*** *

System displays water temperature

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

1.2.0:

Weather information

9. ***1.2.1:*** *

System displays weather forecast

- Including temperature, wind, etc.

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

10. ***1.2.2:*** *

System alerts users when adverse weather are forecasted/observed

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

2. Operational management

2.1.0:

Operational plan management

11. ***2.1.1:*** *

System allows users to create and save operational plan

- Transportation method (ship, truck, rail and its type), route, scheduling, cargo handling operation plan, etc.

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

12. ***2.1.2:*** *

System allows users to modify/adjust the operational plan

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

13. ***2.1.3:*** *

System allows users to view the operational plan

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

14. ***2.1.4:*** *

System provides real-time estimated time of arrival, cargo status, and estimated time of plan completion

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

15. ***2.1.5:*** *

System calculates and suggests optimal transportation plan to transport destination

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

16. ***2.1.6:*** *

System calculates and suggests optimal scheduling and provides information such as optimal sailing speed

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

17. ***2.1.7:*** *

System calculates possible load capacity per route

- Such as With this type of vessel and considering water level, a total of X kg worth of cargo can be loaded to the vessel

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

18. ***2.1.8:*** *

System alerts users about possible need to adjust loading layer, capacity and transport routes

- Such as When the water level rises, the loading layer height needs to be adjusted because it may be caught by the bridge's maximum passing height limit when passing through the bridge

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

19. ***2.1.9:*** *

System alerts users when a transport plan is planned with less than 80% of the vessel's load capacity

- Because regulations could require companies to pay 80% of transportation costs if less than 80% of the cargo is loaded

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

20. ***2.1.10:*** *

System indicates which cargo requires specific inspection before loading and unloading

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

21. ***2.1.11:*** *

System displays information on narrow and difficult waterways, obstructions on waterways, obstructions on transportation routes

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

22. ***2.1.12:*** *

System provides port operation simulation tool

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

23. ***2.1.13:*** *

System provides information on traffic volume and congestion on roads

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

2.2.0:

Ship information

24. ***2.2.1:*** *

System displays an overview of available ships and its information

- Possible load capacity, engine specifications/emissions information, etc.

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

25. ***2.2.2:*** *

System displays real-time vessel navigation status

- Ship number, location, speed, cargo information, load capacity, crew size, availability, etc.

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

26. ***2.2.3:*** *

System displays recreational activities information on the canal

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

2.3.0:

Facilities management

27. ***2.3.1:*** *

System displays the condition status of port facilities along the canal

- Depth and structural strength of the facilities, etc.

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

28. ***2.3.2:*** *

System displays real-time status and information of port facilities along the canal

- Information on availability, operation status, number, size, location of facilities etc.
- Facilities such as berths, docking facilities, loading/unloading platforms, etc.

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

29. ***2.3.3:*** *

System suggests regular maintenance and upgrade schedules based on predictive maintenance algorithms

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

2.4.0:

Bridge and lock management

30. ***2.4.1:*** *

System displays bridges/locks information along the canal

- Bridge height restrictions, malfunctions, maintenance schedules, open time, difficulties in opening bridges, rules(e.g. passing speed, maximum loading capacity) etc.

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

31. ***2.4.2:*** *

System displays real-time waiting time at the locks and bridges

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

32. ***2.4.3:*** *

System displays real-time operational status of lock/bridge

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

33. ***2.4.4:*** *

System updates lock status at least every 30 minutes

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

34. ***2.4.5:*** *

System alerts users when there is a malfunction with bridge or lock

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

2.5.0:

Cost management

35. ***2.5.1:*** *

System calculates expected transportation cost based on operational plan

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

2.6.0:

Fuel/CO2 emission management

36. ***2.6.1:*** *

System notifies users when weather and environmental factors that significantly affect fuel consumption are observed along the transportation route

- Such as wind strength and direction, temperature and wave height

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

37. ***2.6.2:*** *

Systems calculate and displays the amount of fuel required per route

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

38. ***2.6.3:*** *

System displays estimated CO2 emission information for transportation plan available on the route

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

39. ***2.6.4:*** *

System calculates and displays CO2 emission after completion of transportation

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

3. Storage management

40. ***3.1:*** *

System allows users to manage inventory information for their warehouses

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

4. Data sharing & Collaboration

4.1.0:

Communication channel

41. ***4.1.1:*** *

System provides communication channel for inter-organizational communication

- Between companies, company-government, etc.

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

42. ***4.1.2:*** *

System provides communication channels for each of the various locations

- Such as at berths, docking facilities, locks, bridges, etc.

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

43. ***4.1.3:*** *

System provides communication channels between vessels and lock, bridge operator

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

44. ***4.1.4:*** *

System provides communication channels for sharing information regarding recreational activities on the waterways

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

45. ***4.1.5:*** *

System provides communication channel for emergency communication with government and carriers

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

46. ***4.1.6:*** *

System provides communication channels to share information about return trip

- Help to reduce the number of empty return trips

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

47. ***4.1.7:*** *

System provides communication channels between vessels in operation

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

48. ***4.1.8:*** *

System provides communication channel between shipowner and factory to coordinate loading/unloading time

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

49. ***4.1.9:*** *

System provides communication channel to communicate with Dutch rail transport management department

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

4.2.0:

Information hub

50. ***4.2.1:*** *

System displays weather, river news, etc.

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

51. ***4.2.2:*** *

System provides information hub to share information from government

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

52. ***4.2.3:*** *

Systems provides information on potential disruptions through predictive analysis based on historical data and current conditions

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

53. ***4.2.4:*** *

System provides contact information for ports, locks, and related companies

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

54. ***4.2.5:*** *

System provides information on emergency contact, response guideline information, evacuation route and plan

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

55. ***4.2.6:*** *

System provides information related to social service facilities available in the docking area

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

56. ***4.2.7:*** *

System alerts users when a vessel is no longer able to pass through a particular area

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

57. ***4.2.8:*** *

System alerts users immediately when navigation along the river is restricted to one-way traffic

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

58. ***4.2.9:*** *

System displays port fees and other costs incurred at ports by port

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

5. Additional Requirements

5.1.0:

Account

59. ***5.1.1:*** *

System provides role-based access control

- Accounts with different permissions and access levels

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

60. ***5.1.2:*** *

System limits the account types that can send/read messages per communication channel

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

61. ***5.1.3:*** *

System limits the account types that create, modify, view operational plan

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

5.2.0:

Payment

62. ***5.2.1:*** *

System provides functionality for payment of canal passage fees and port fees

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

Now, we move to Non-functional requirements.

1. Reliability

63. ***1.1:*** *

System provides only reliable and accurate data

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

64. ***1.2:*** *

System provides long-term, accurate water level forecasts with over 70% accuracy

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

2. Security

65. ***2.1:*** *

Information such as vessel location, cargo information, etc. are protected by a sophisticated security system

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

3. Usability

66. ***3.1:*** *

UI is understandable and actionable, even for users without a technical background

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

4. Compatibility

67. ***4.1:*** *

The UI displays on Smartphone, Tablet and Desktop displays

Mark only one oval.

	1	2	3	4	
No r	◯	◯	◯	◯	Must have

68. Are there any features/requirements that have not been mentioned so far but you would like to have in the system? *

69. Is there anything else you would like to mention about?