Survey Results on Wireless Communication /5G Utilization in Manufacturing

April 25,2025

5G Alliance for Connected Industries and Automation (5G-ACIA)

Flexible Factory Partner Alliance（FFPA)

XGMF ODAIBA IX Core Project

Notes:

- Although statistically significant responses were not obtained for all questions, the survey targeted knowledgeable individuals, and certain trends are expected to emerge. Readers are encouraged to interpret the survey results and analysis based on their own experiences and insights.

- Wi-Fi is a registered trademark of the Wi-Fi Alliance.
- Bluetooth is a registered trademark of Bluetooth SIG.

Contents:

- Survey overview
  - Purpose
  - Methodology
- Questions
- Results
  1. Overall analysis of all responses
  2. ICT/OT/ End-users/ Analyze separately
- Overall summary
- 【Reference】

Survey Overview

Purpose:

- There is a growing expectation for the utilization of wireless communication in the industry. To further promote its adoption, it is necessary to understand the current situation, identify challenges, and clarify solutions.
- This survey aims to recognize and share which issues and solutions are most important for end-users, vendors, and system providers, and to determine which should be prioritized.

Methodology:

- In this survey, the first half consisted of questions about wireless communication, and the second half focused on local 5G.
- Respondents were asked to provide their opinions as individuals, not as representatives of their organizations. Multiple responses from a single organization were allowed.

- **Period**: March 4, 2025 - April 2, 2025
- **Survey Participants**: Members of XGMF, FFPA/VoC Community, 5G-ACIA, and FSPJ*member (residents in Japan)
- **Method**: Survey participants were asked to respond via Google Forms through an email request.
- **Number of Requests Sent**: Approximately 800 (XGMF: ~550, FFPA/VoC: ~200, Others: ~50)
- **Number of Responses**: 78

*FSPJ：Flexible Society Project (NICT joint research project)

5G ACIA 5G Alliance for Connected Industries and Automation

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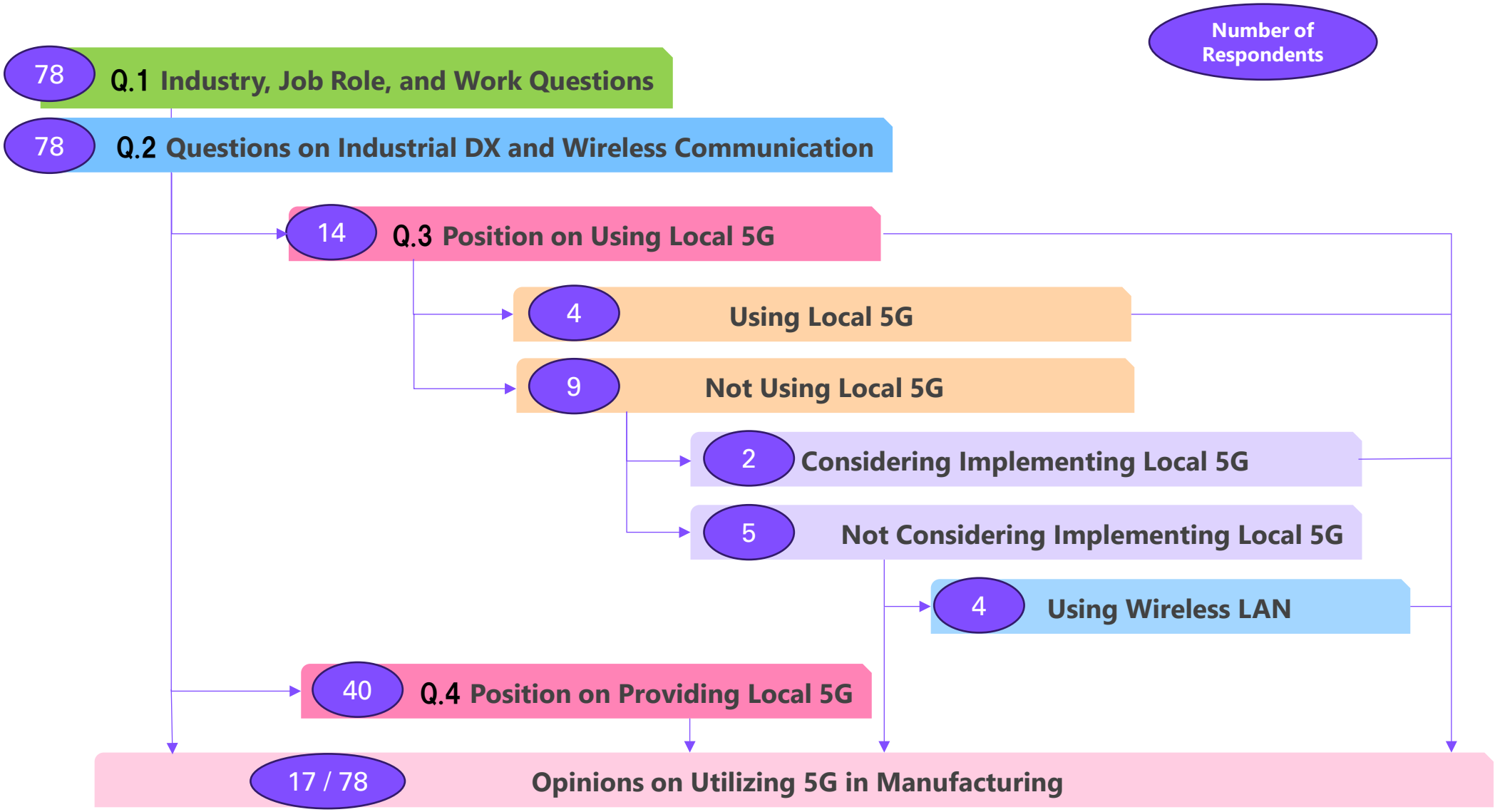
Questions

Survey Structure and Number of Responses:



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Q.1 Industry, Job Role, and Work Questions

- Q.1-1 What is the industry of your company/organization?
- Q.1-2 What is your job role?
- Q.1-3 What is your role and tasks related to promoting industrial DX?

Q.2 Questions on Industrial DX and Wireless Communication

- Q.2-1 What applications are considered essential for driving industrial digital transformation? (Multiple responses allowed)
- Q.2-2 Which applications are particularly effective for utilizing wireless communication?(Multiple responses allowed)
- Q.2-3 What types of wireless communication are used at your site or by your customers? (Multiple answers allowed)
- Q.2-4 Are you satisfied with the quality of wireless communication used in your field or by your customers?
- Q.2-5 What types of wireless communication are expected to be used at your site or by your customers in the next 3 years? (Multiple answers allowed)
- Q.2-6 What do you consider to be the challenges of wireless communication? (Multiple responses allowed)
- Q.2-7 What is your position regarding local 5G?

Q.3 Position on Using Local 5G(1)

Q.3-1 Has your company/organization implemented local 5G?

Opinions from Companies/Organizations Using Local 5G

- Q.3-2 What applications are you using the implemented local 5G for? (Multiple responses allowed)
- Q.3-3 What were the challenges or concerns in implementing local 5G? (Multiple responses allowed)
- Q.3-4 Approximately how much did the total cost of implementing local 5G amount to?

Opinions from Companies/Organizations Not Using Local 5G

- Q.3-5 Are you considering implementing local 5G?

Opinions from Companies/Organizations Considering Implementing Local 5G

- Q.3-6 What applications are you considering implementing local 5G for? (Multiple responses allowed)
- Q.3-7 What are the challenges or concerns in considering the implementation of local 5G? (Multiple responses allowed)
- Q.3-8 What are the business challenges in considering the implementation of local 5G? (Multiple responses allowed)
- Q.3-9 What is the approximate budget for implementing local 5G?

Q.3 Position on Using Local 5G(2)

- **Opinions from Companies/Organizations Not Considering Implementing Local 5G**
- Q.3-10 What are the reasons for not considering the implementation of local 5G? (Multiple responses allowed)
- Q.3-11 Have you implemented any communication networks other than local 5G?

Opinions from Companies/Organizations Using Wi-Fi (Wireless LAN)

- Q.3-12 Are you satisfied with the quality of Wi-Fi (Wireless LAN)?If possible, please explain the reasons for your answer.
- Q.3-13 What applications are you using Wi-Fi (Wireless LAN) for? (Multiple responses allowed)

Q.4 Position on Providing Local 5G

- Q.4-1 What applications are you using the provided local 5G for? (Multiple responses allowed)
- Q.4-2 What are the challenges or concerns in implementing local 5G? (Multiple responses allowed)
- Q.4-3 What is the approximate budget for implementing local 5G?
- Q.4-4 What are the business challenges in considering the implementation of local 5G? (Multiple responses allowed)

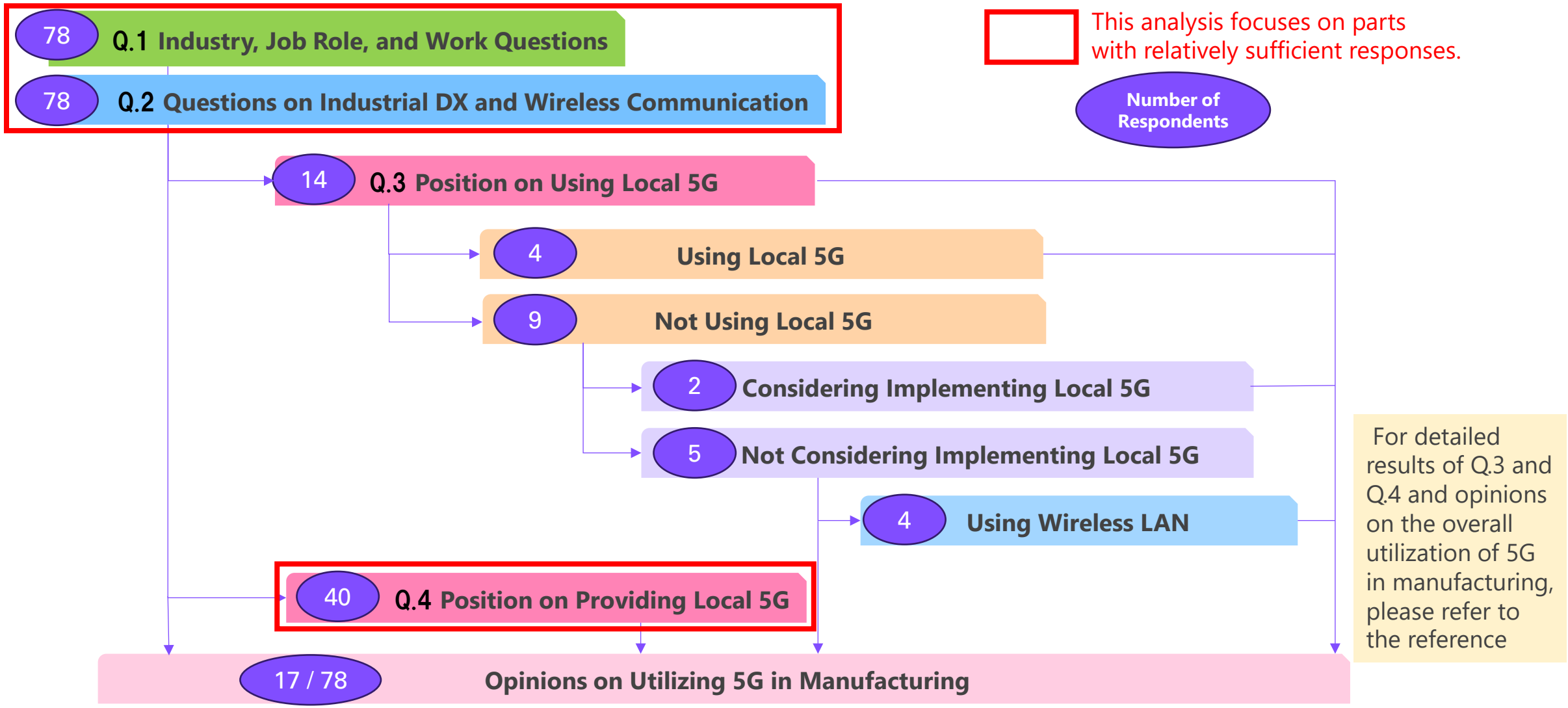
Survey Results

1. Overall analysis of all responses
2. Analysis per ICT/OT/end-users

ICT: Information and Communication Technology
OT: Operational Technology

1. Overall analysis of all responses

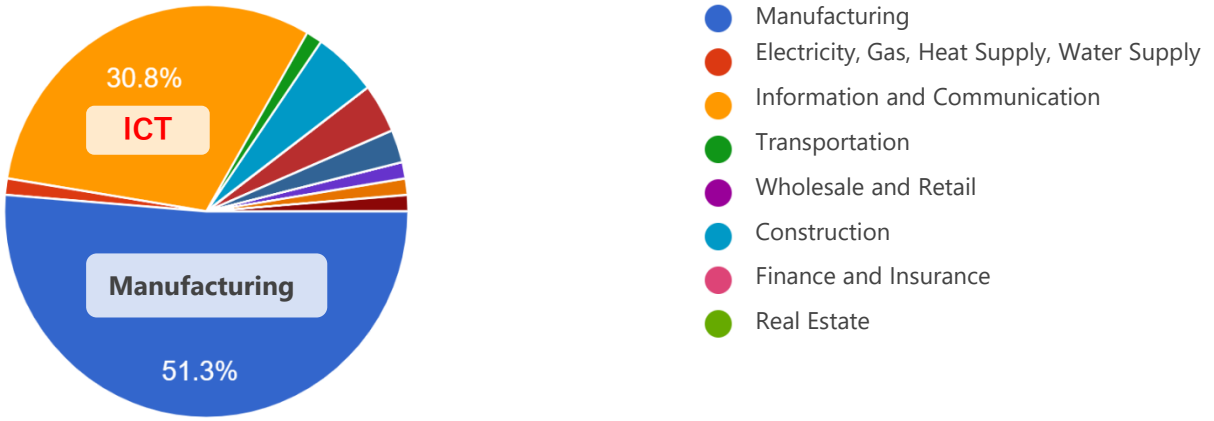
Overall analysis of all responses :



Q.1 Industry, Job Role, and Work Questions

Q.1-1 **What is the industry of your company/organization?**

78 responses

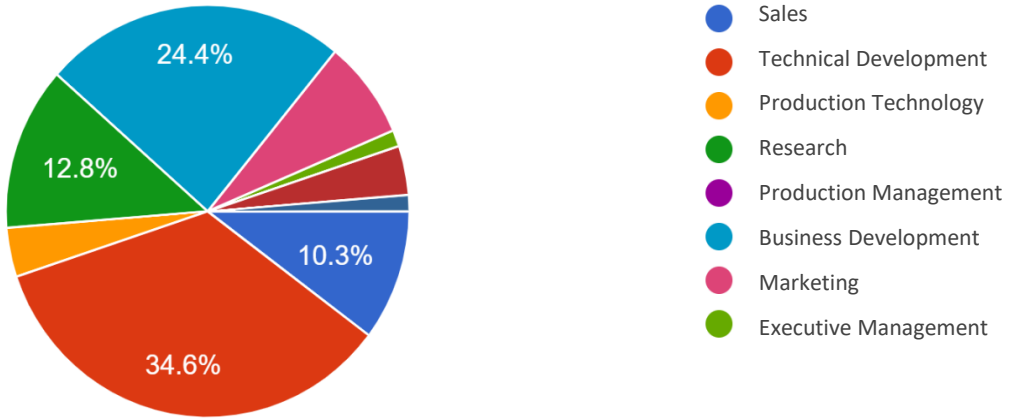


- Responses from the Information and Communication Technology (ICT) industry account for 30%, while responses from industries other than ICT account for 70%.
- Particularly, more than half of the responses are from the manufacturing industry, adequately reflecting the opinions from the manufacturing sector.

Q.1 Industry, Job Role, and Work Questions

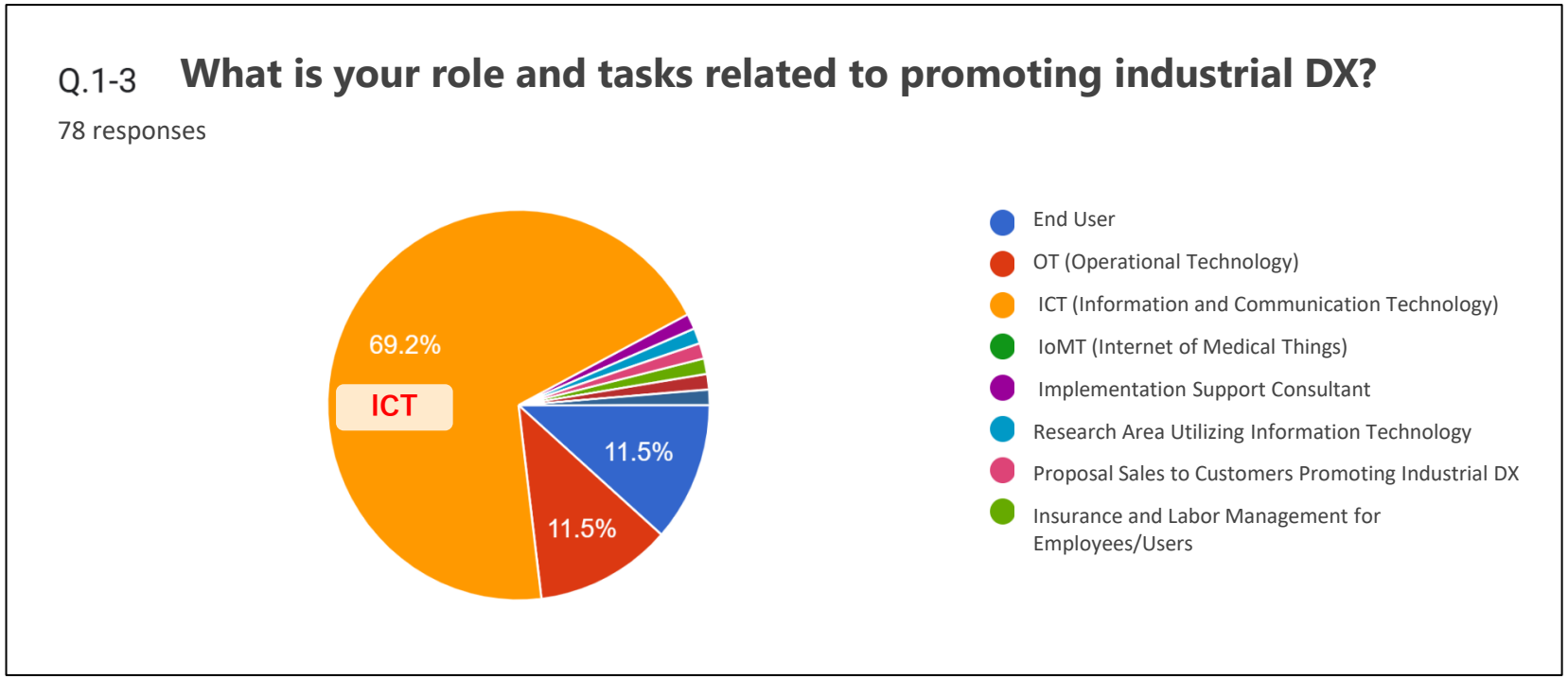
Q.1-2 **What is your job role?**

78 responses



- Responses were received from various job roles, with technology development and business development being the top roles.

Q.1 Industry, Job Role, and Work Questions

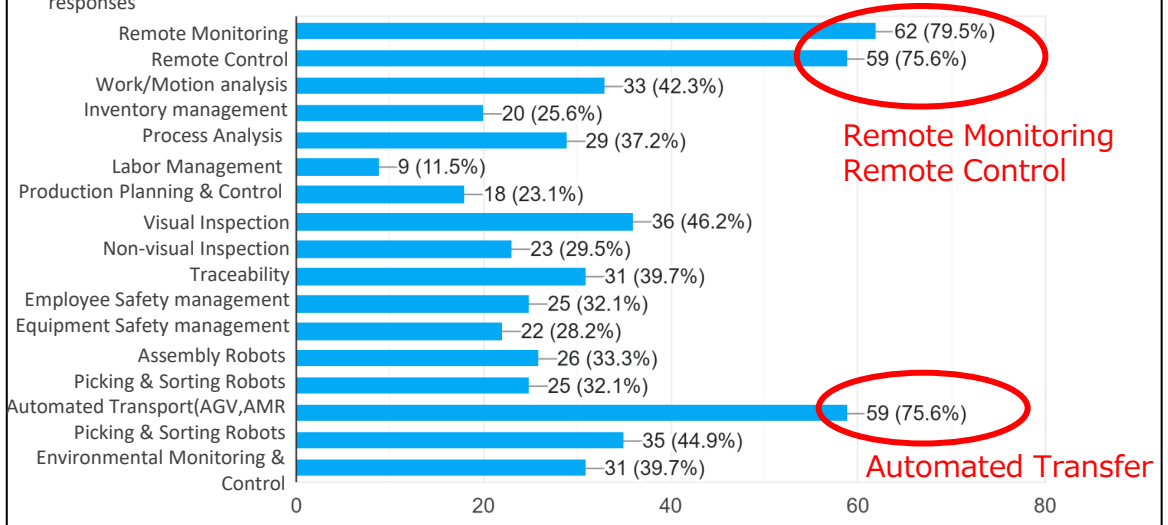


- About 70% of respondents are involved in ICT-related work.
- ICT Work Breakdown by Industry: Many responses were received from ICT professionals in companies/organizations outside the ICT industry, including manufacturing.
  - Information and Communication Industry: 22 (41%)
  - Manufacturing Industry: 22 (41%)
  - Other Industries: 10 (19%)
- About 10% of responses were from OT and end-user roles, reflecting some opinions from those not involved in ICT work. For detailed analysis per ICT/OT/end-user roles, please refer to the next section.

Q.2 Questions on Industrial DX and Wireless Communication

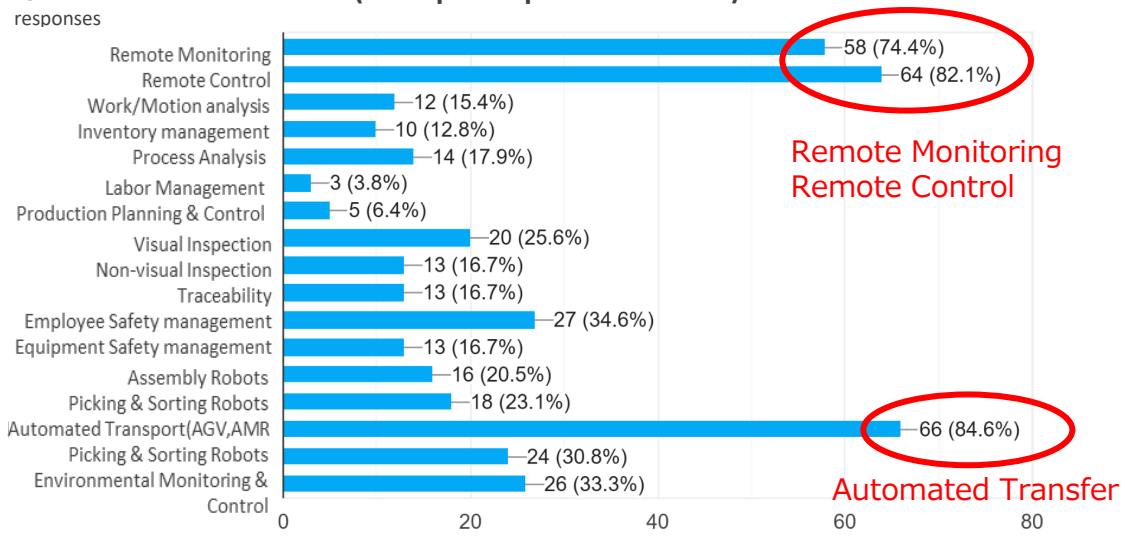
Q.2-1 What applications are considered essential for driving industrial digital transformation? (Multiple responses allowed)

78 responses



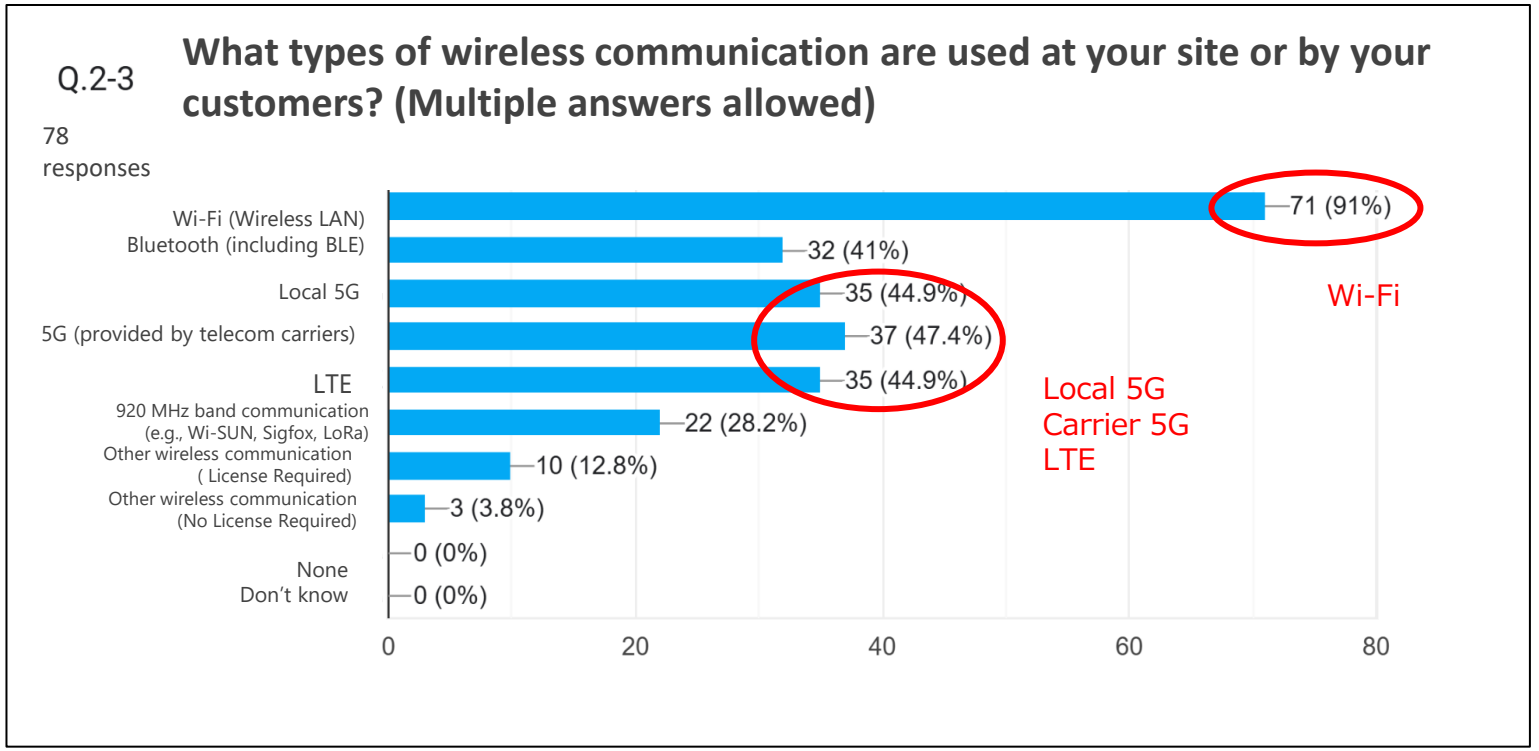
Q.2-2 Which applications are particularly effective for utilizing wireless communication?(Multiple responses allowed)

78 responses



- Remote monitoring, remote operation, and automated transport are prominent in both industrial DX and wireless communication utilization, indicating the potential effectiveness of wireless communication in promoting industrial DX. Wireless communication utilization is more focused on specific applications (remote monitoring, remote operation, automated transport), while industrial DX is slightly more varied. For detailed analysis per ICT/OT/end-user roles, please refer to the next section.

Q.2 Questions on Industrial DX and Wireless Communication



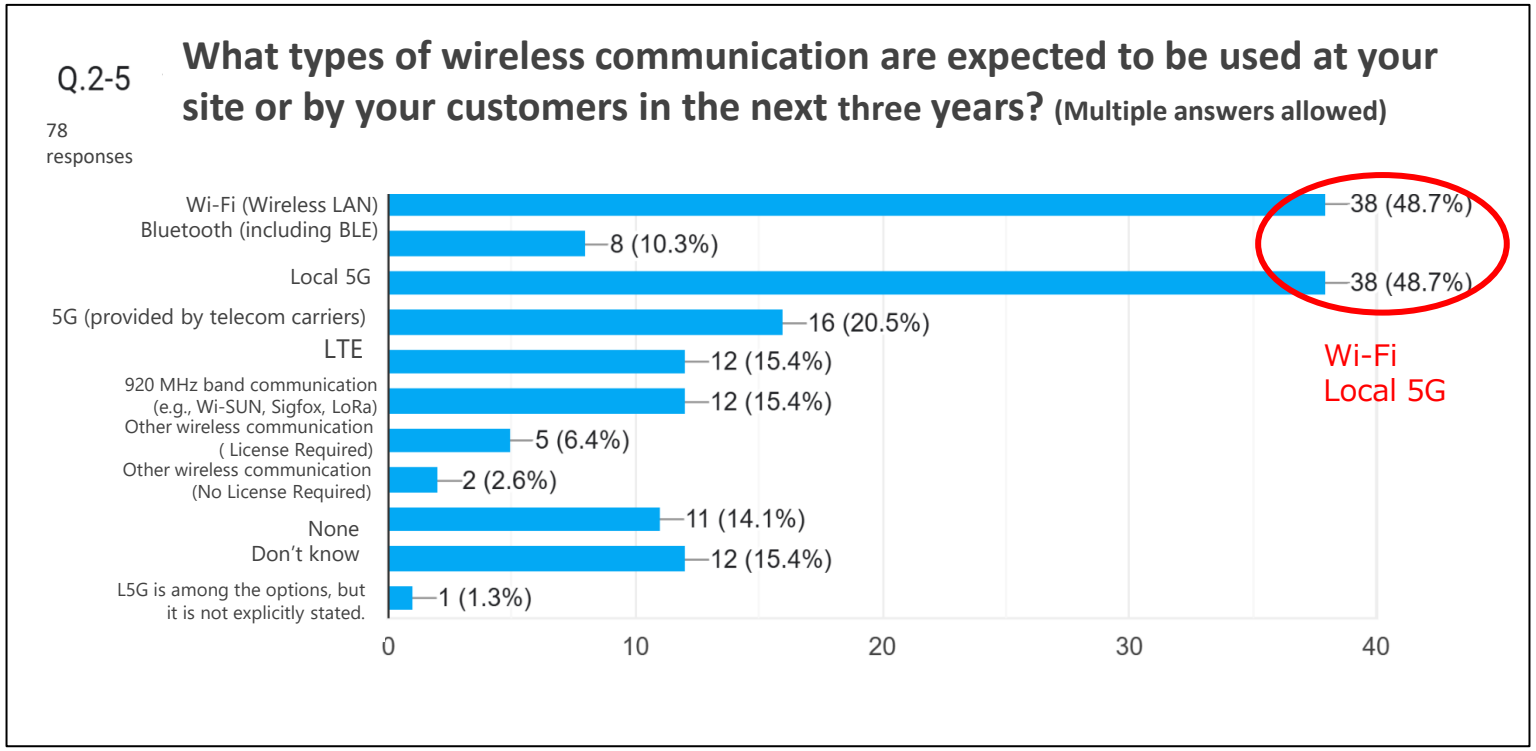
- Wi-Fi remains the primary wireless communication method.
- Local 5G and Carrier 5G: Both are on par with LTE in terms of usage, but nearly 70% of respondents are dissatisfied.

Q.2-4 **Are you satisfied with the quality of wireless communication used in your field or by your customers?**

78 responses

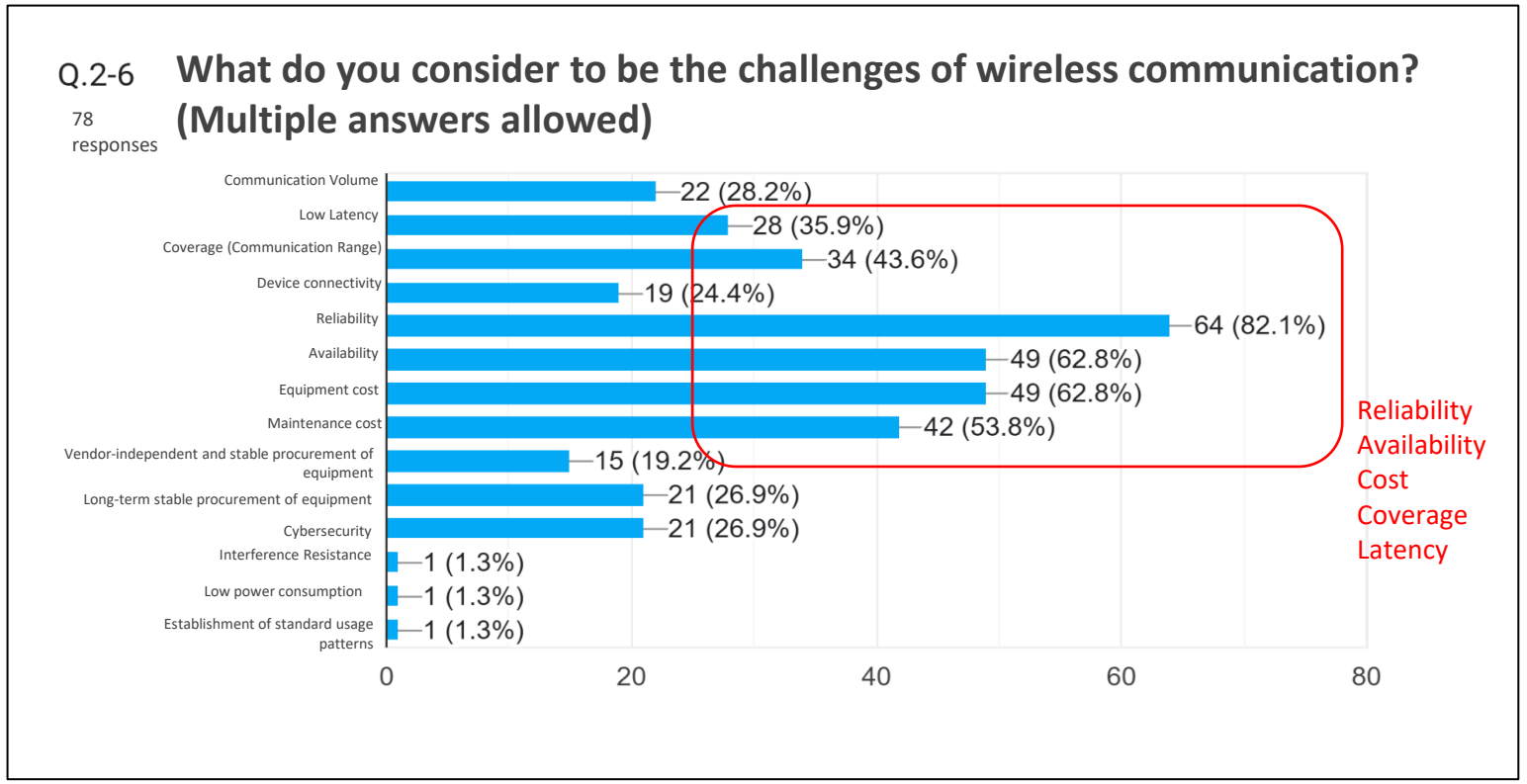
- Nearly 70% are dissatisfied.
- The aspects of wireless communication they are dissatisfied with are analyzed in Q.2-6.

Q.2 Questions on Industrial DX and Wireless Communication



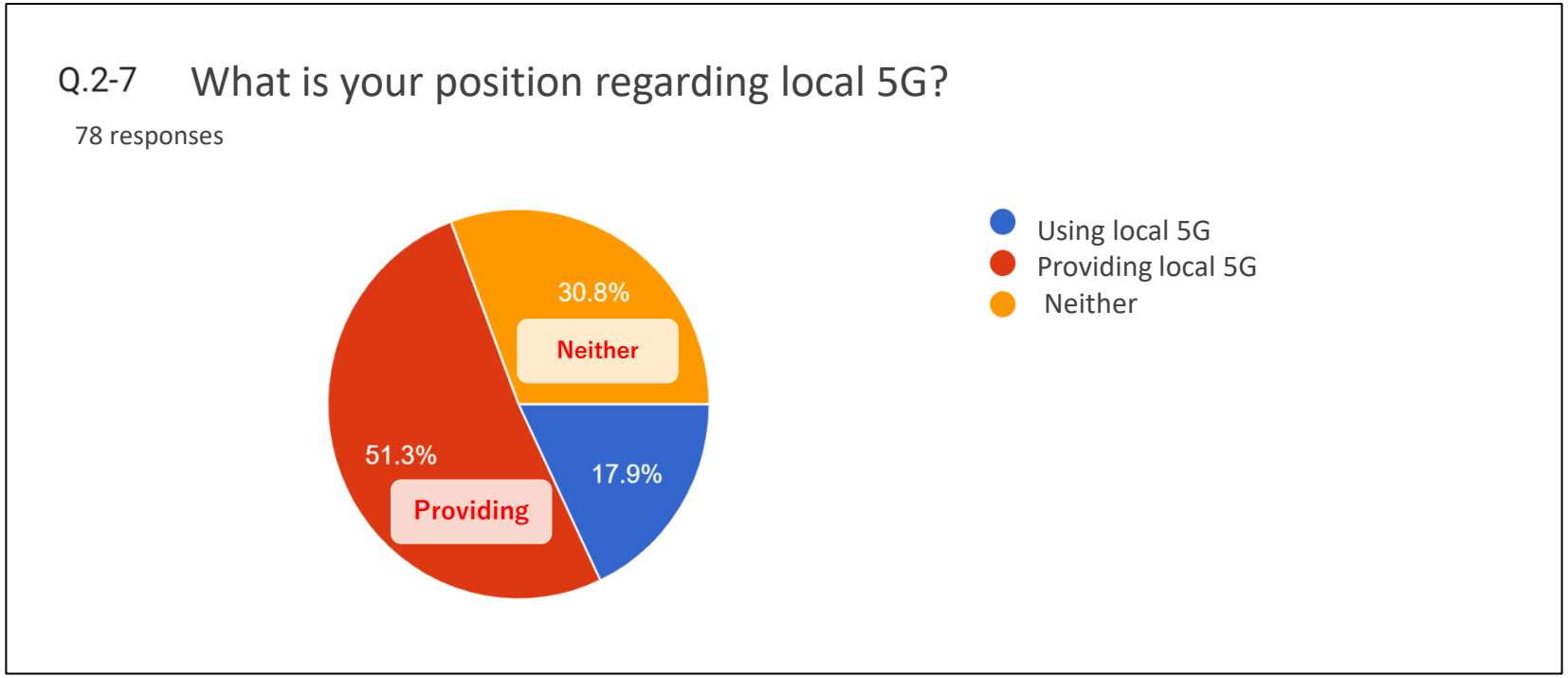
- Local 5G has the same level of expectation with Wi-Fi.
- It is overwhelmingly more anticipated than carrier 5G.

Q.2 Questions on Industrial DX and Wireless Communication



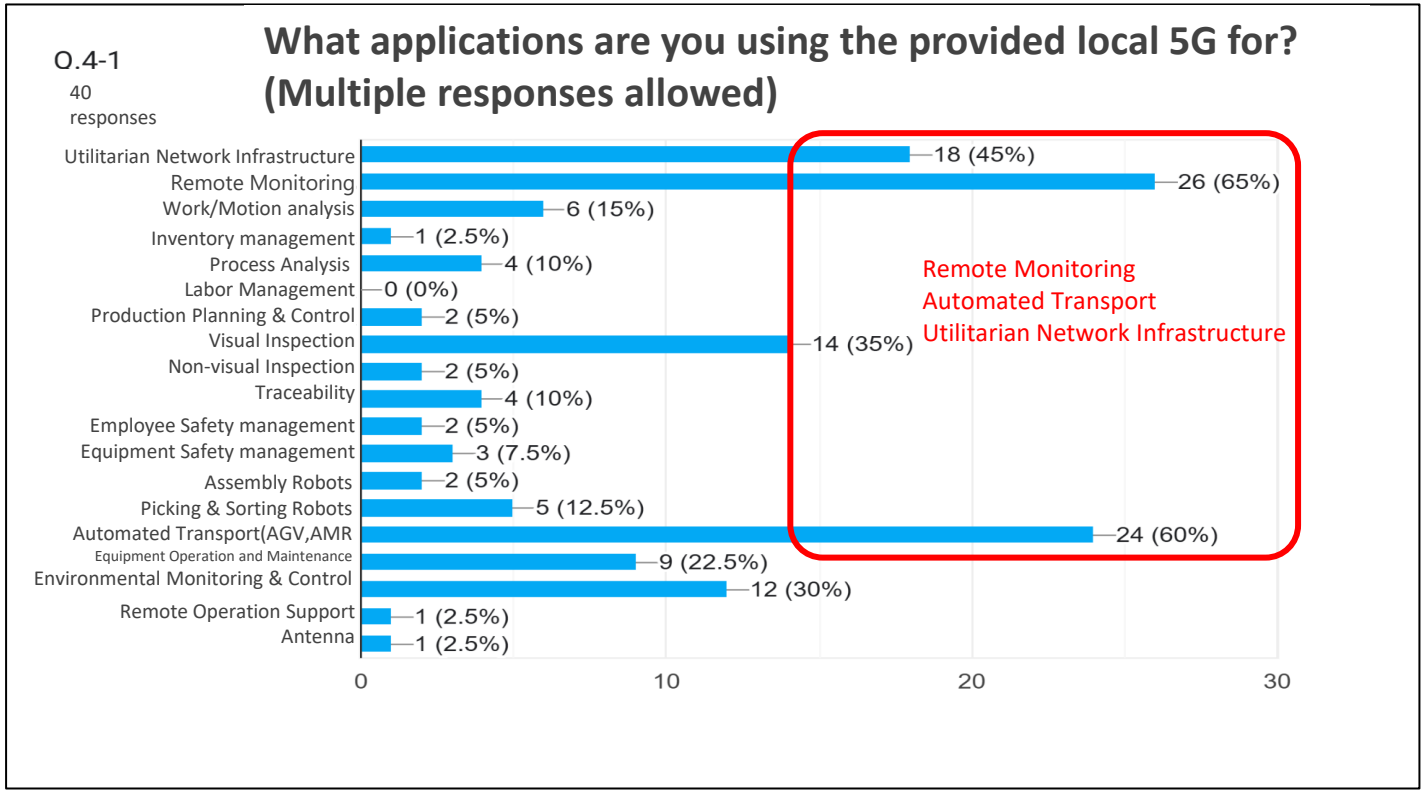
- Reliability, availability, cost, and coverage are prioritized over capacity and latency.
- Latency is also a concern.

Q.2 Questions on Industrial DX and Wireless Communication



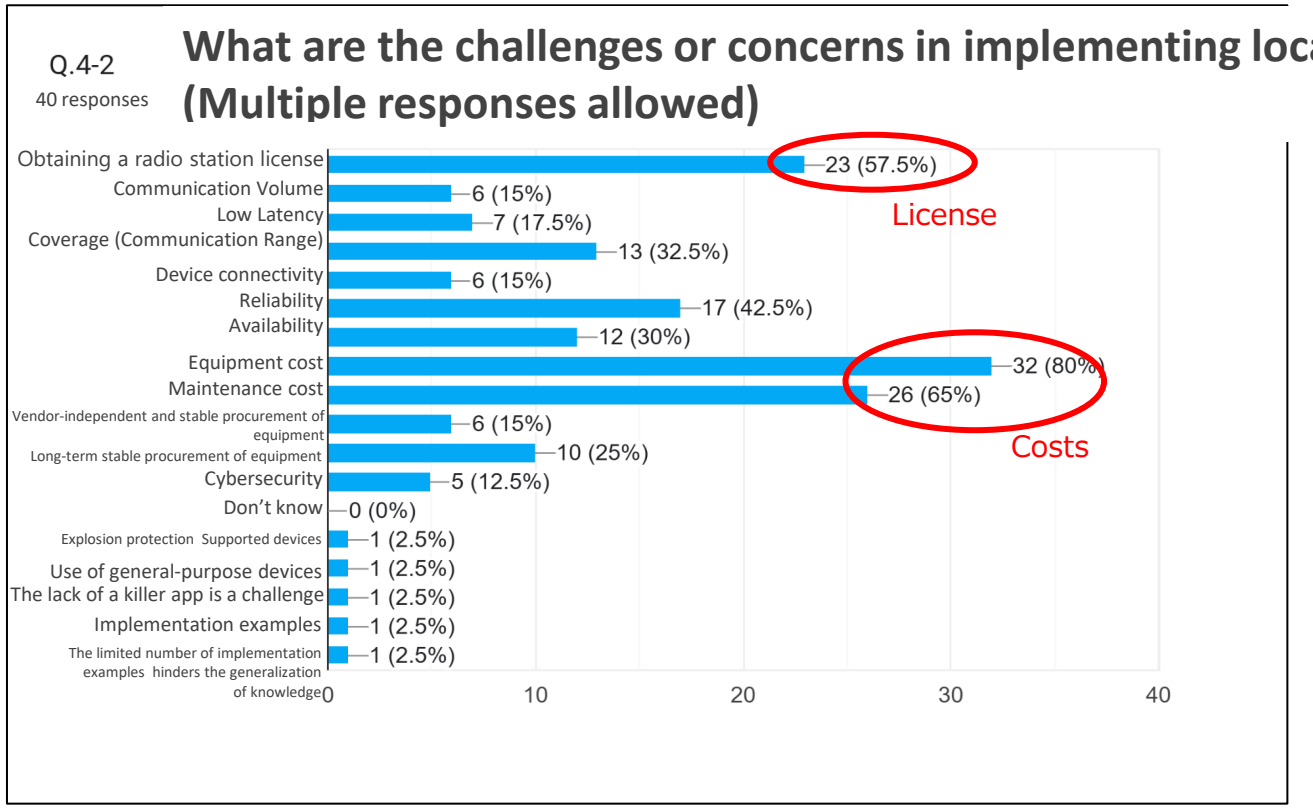
- The positions of ‘local 5G provider’ and ‘local 5G user or neither’ are roughly equal, indicating that the survey results are not biased towards the opinions of the providers.
- Approximately 18% of respondents expressed a position of local 5G user, which is a minority. In contrast, about 30% of respondents are in the "neither" position.
- The original intent of the question was to ask whether respondents were more on the providing side or the user side. However, the phrasing "position of local 5G user" may have been interpreted as a position of a local 5G user who already decided to use local 5G.

Q.4 Opinions from the position of providing local 5G



- High Expectations for Remote Monitoring and Automated Transport.
- These applications are highly valued, along with general network infrastructure uses.

Q.4 Opinions from the position of providing local 5G

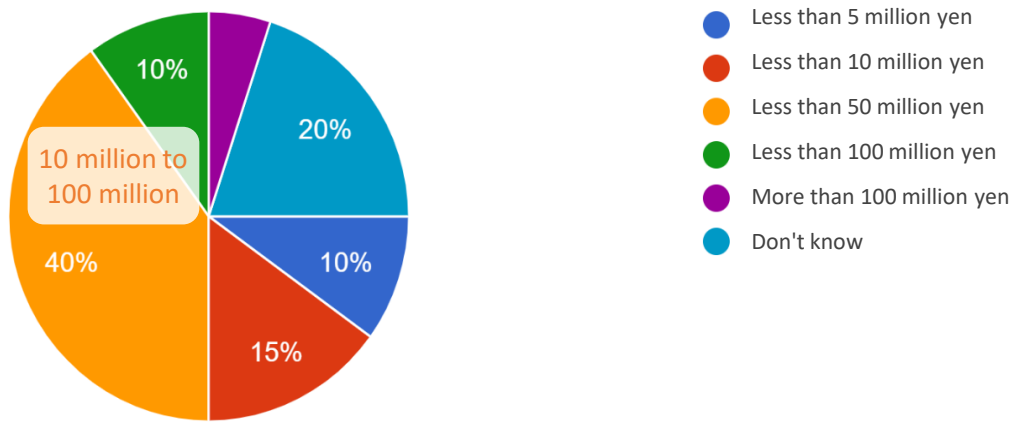


- Cost remains a significant concern, with radio licensing also being a high priority.
- Reliability, availability, and coverage are also crucial.

Q.4 Opinions from the position of providing local 5G

Q.4-3 **What is the approximate budget for implementing local 5G?**

40 responses



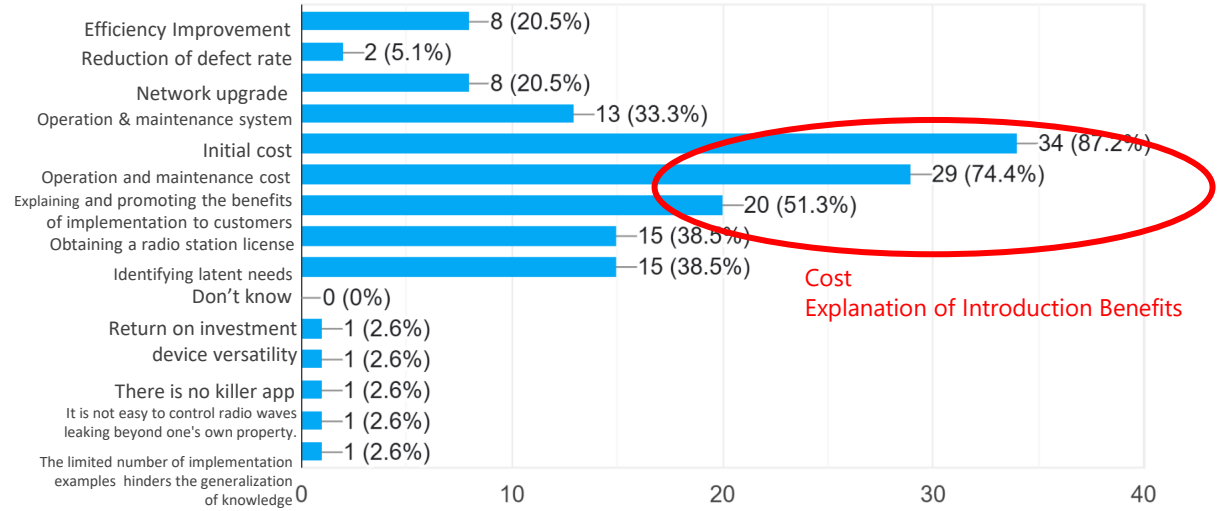
- Half of the responses indicate a budget of 10 million to 100 million yen. In contrast, the responses to Q.3-9 (though there are only two responses) indicate a budget of 5 to 10 million yen, showing a discrepancy.

Q.4 Opinions from the position of providing local 5G

Q.4-4

39 responses

What are the business challenges in considering the implementation of local 5G? (Multiple responses allowed)

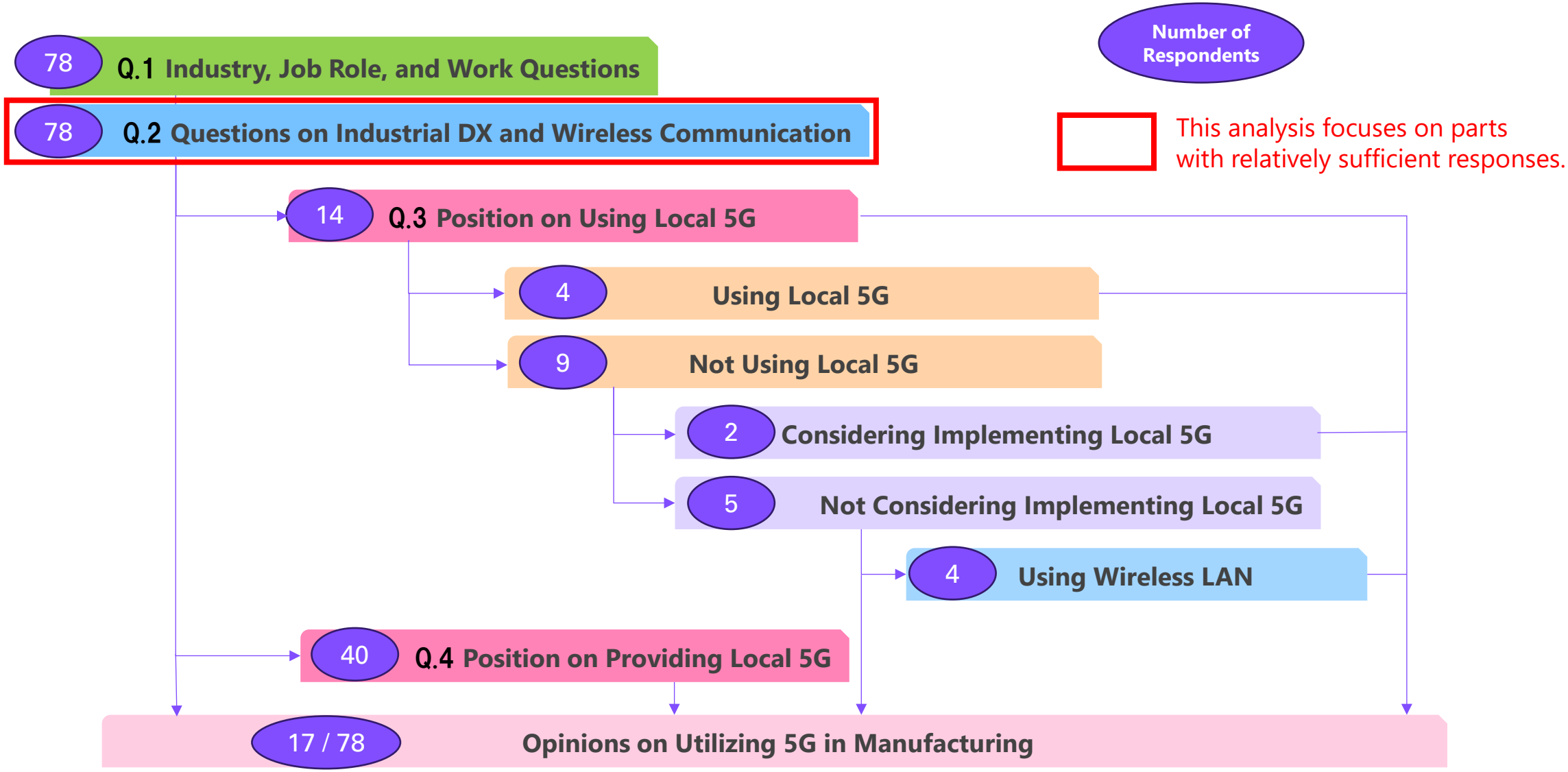


- Cost remains a significant factor.
- Explaining the benefits of introduction is also important.
- Challenges include licensing and uncovering potential needs.

2. Analysis per ICT/OT/end-users

Analysis of survey responses related to industrial wireless communication, categorized by ICT stakeholders, OT stakeholders, and end users.

ICT/OT/ Analysis by end-users :



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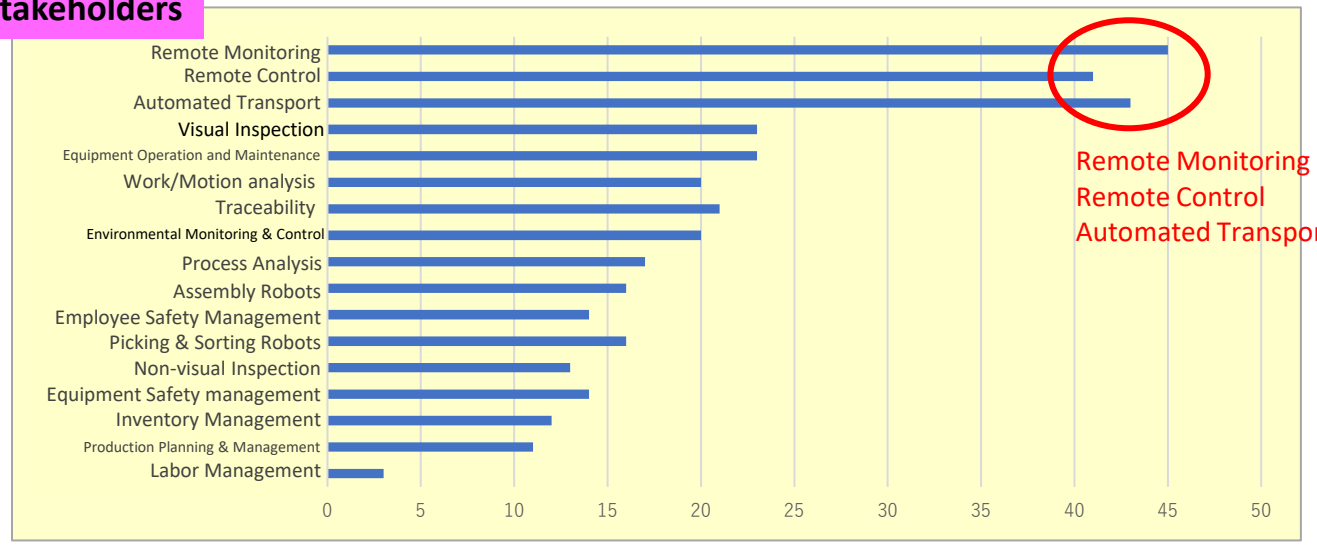
Important applications and noteworthy applications for promoting industrial DX

ICT stakeholders



ICT : Focus on remote monitoring, remote operation, and automated
OT : Responses are less concentrated on specific applications.
End-Users: Although the number of responses is small, they are spread across a wide range of applications.

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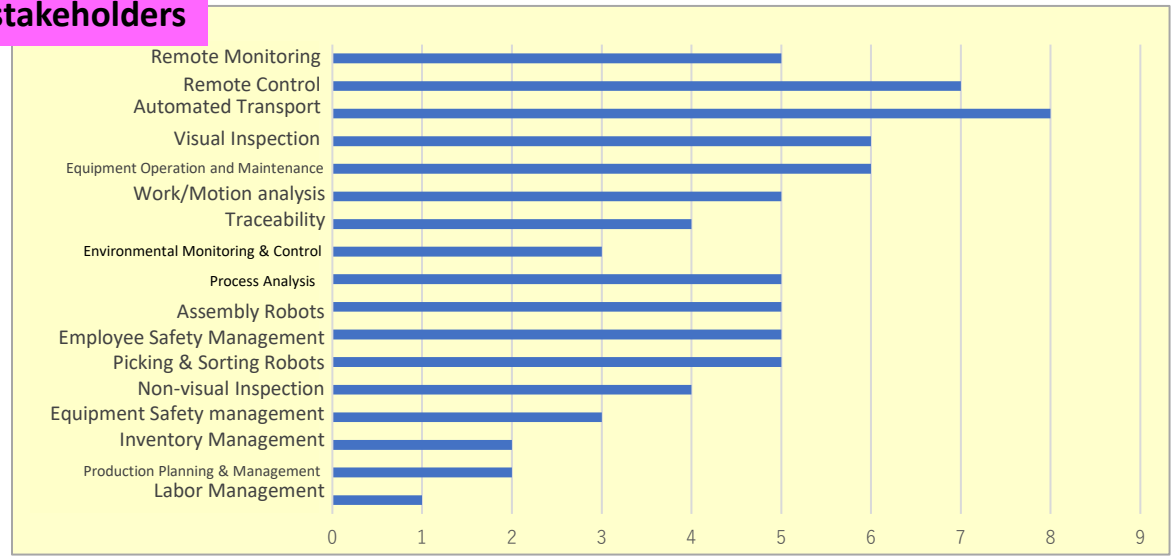
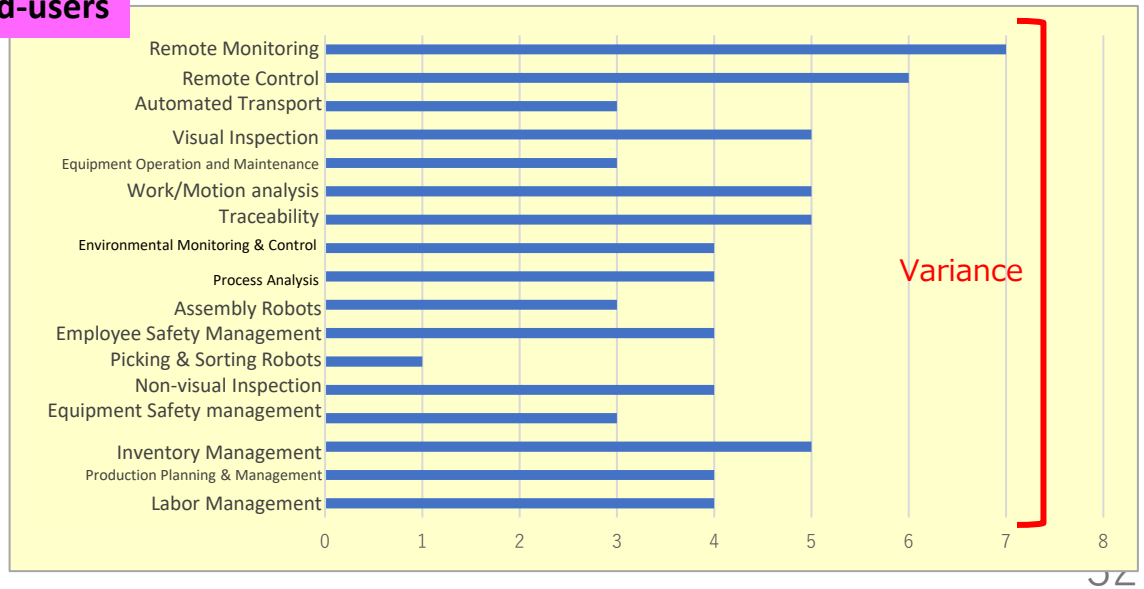
End-users are considering a broad range of applications in the context of industrial digital transformation (DX).

OT stakeholders

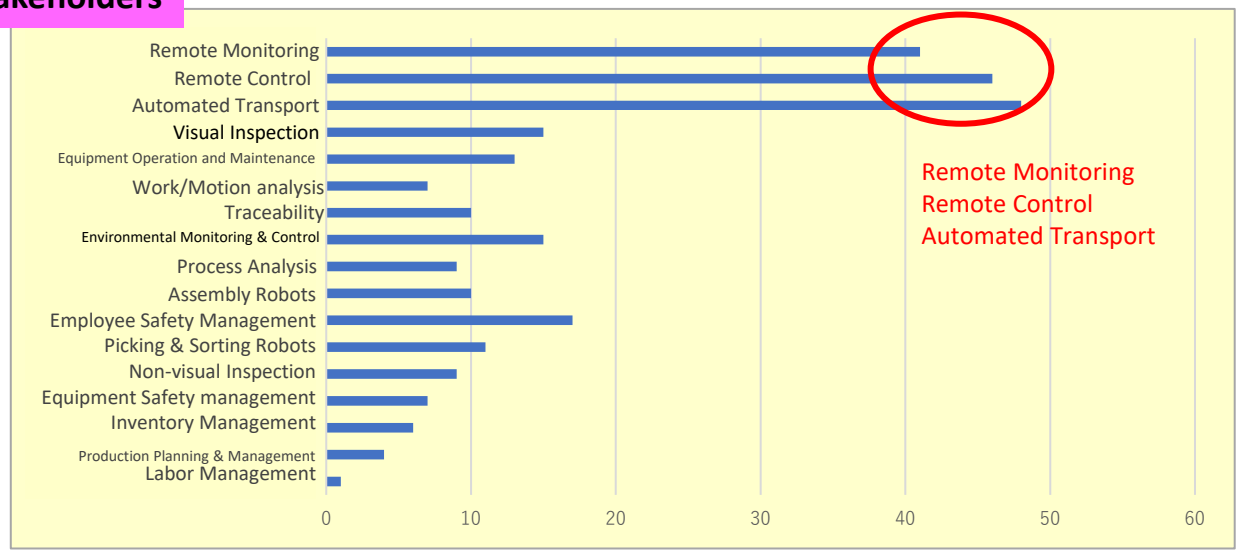


End-users



Applications where the use of wireless communication is particularly effective

ICT stakeholders



ICT , OT, and End-users： Responses are concentrated on remote monitoring, remote operation, and automated transport.

End users： Although the number of responses is small, in addition to the above, responses are also concentrated on equipment operation and maintenance, environmental monitoring and control, and safety management (employees).

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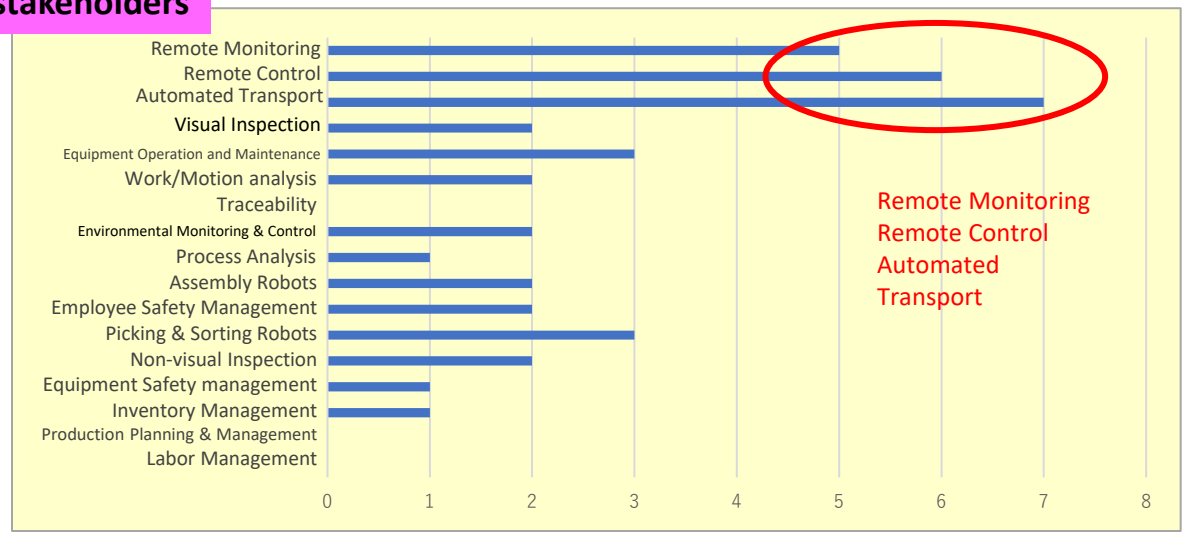
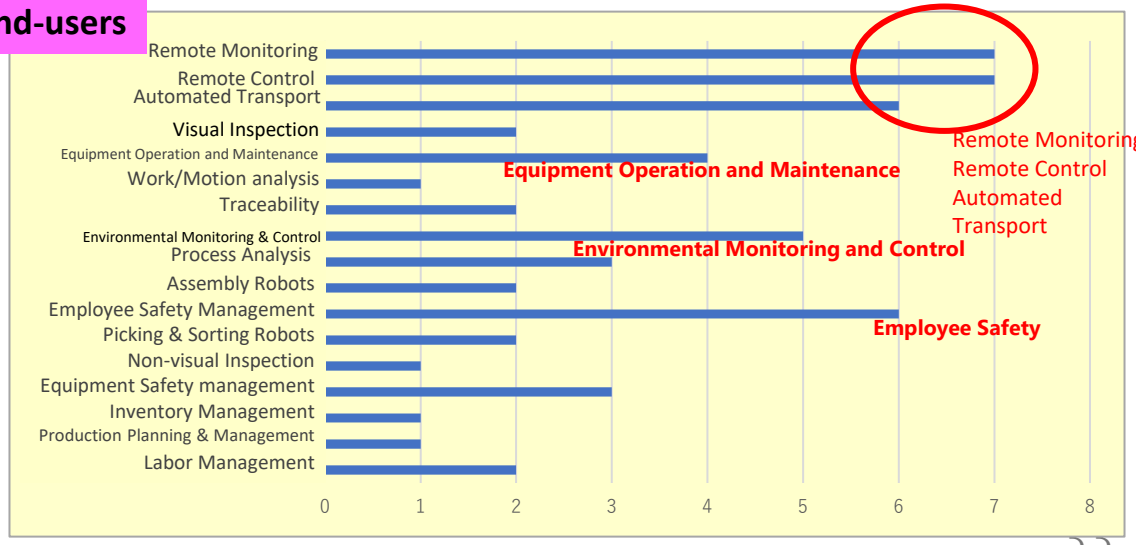
In the context of wireless communication, all stakeholders commonly consider remote monitoring, remote operation, and automated transport to be effective. End-users also expect the utilization of wireless communication in other areas.

OT stakeholders

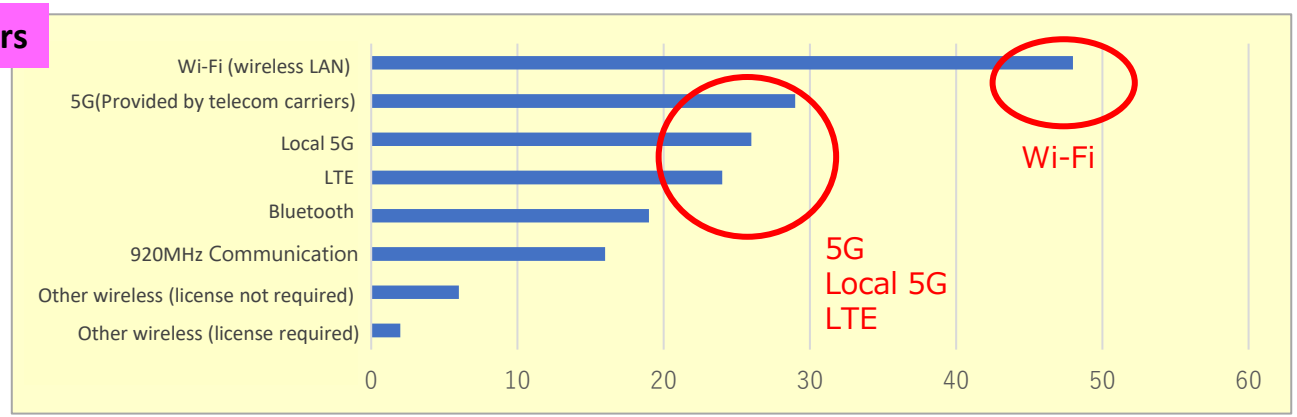


End-users

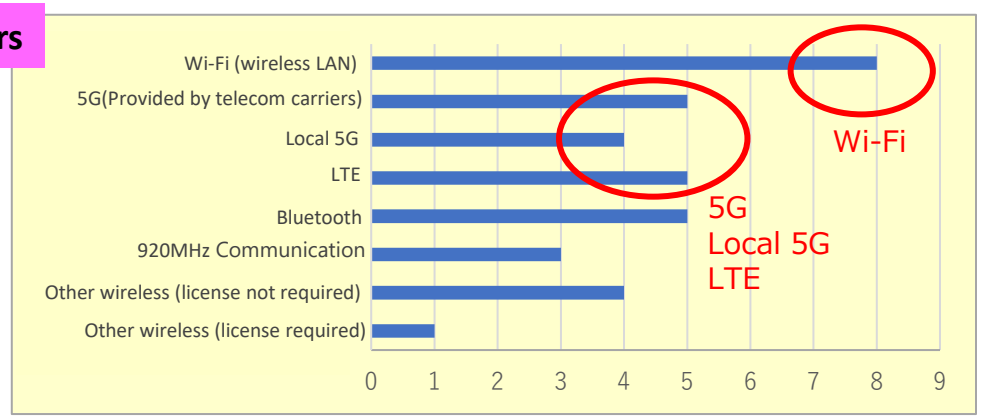


Types of wireless communication used in your own field (end-users) and by your customers (vendors)

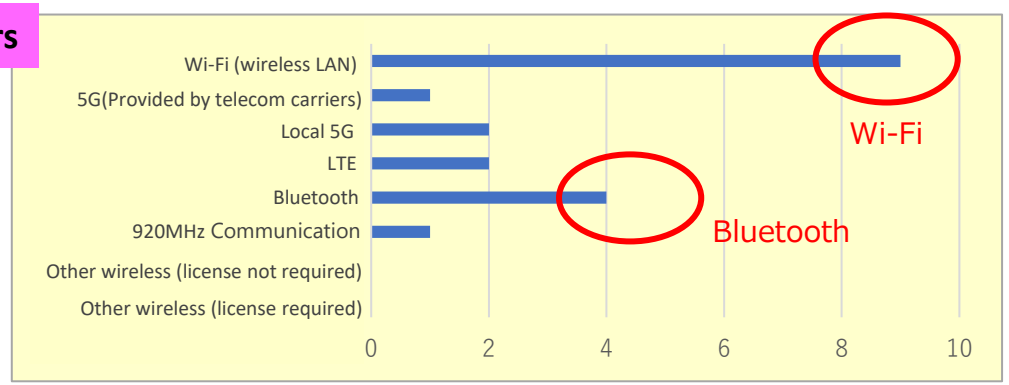
ICT stakeholders



OT stakeholders



End-users



ICT, OT：Wi-Fi accounts for the majority, but the number of each responses for 5G, Local 5G, and LTE is about half that of Wi-Fi.

End-users：Wi-Fi is the most common, followed by Bluetooth.

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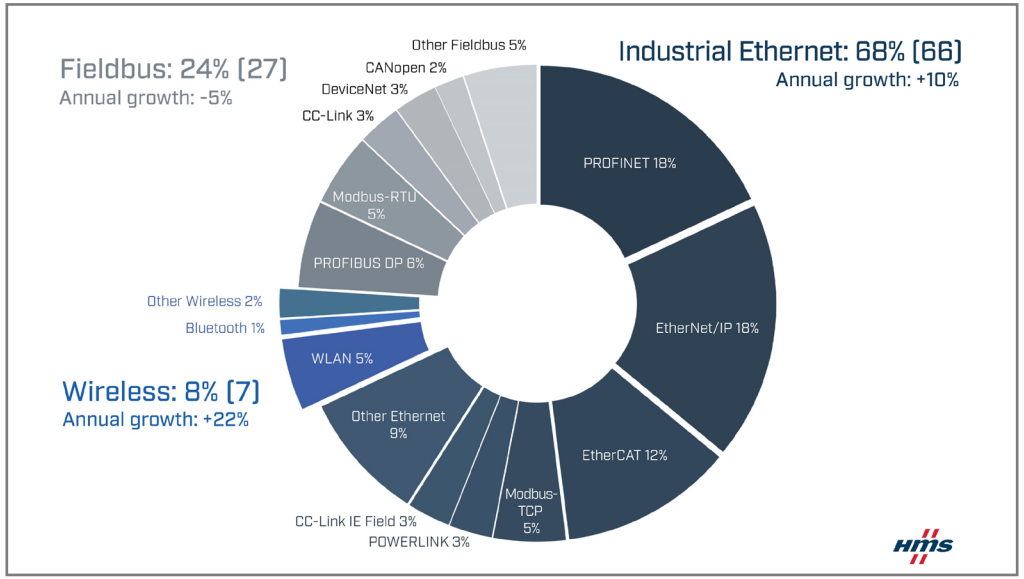
The trend in end-user responses aligns with the HMS survey.

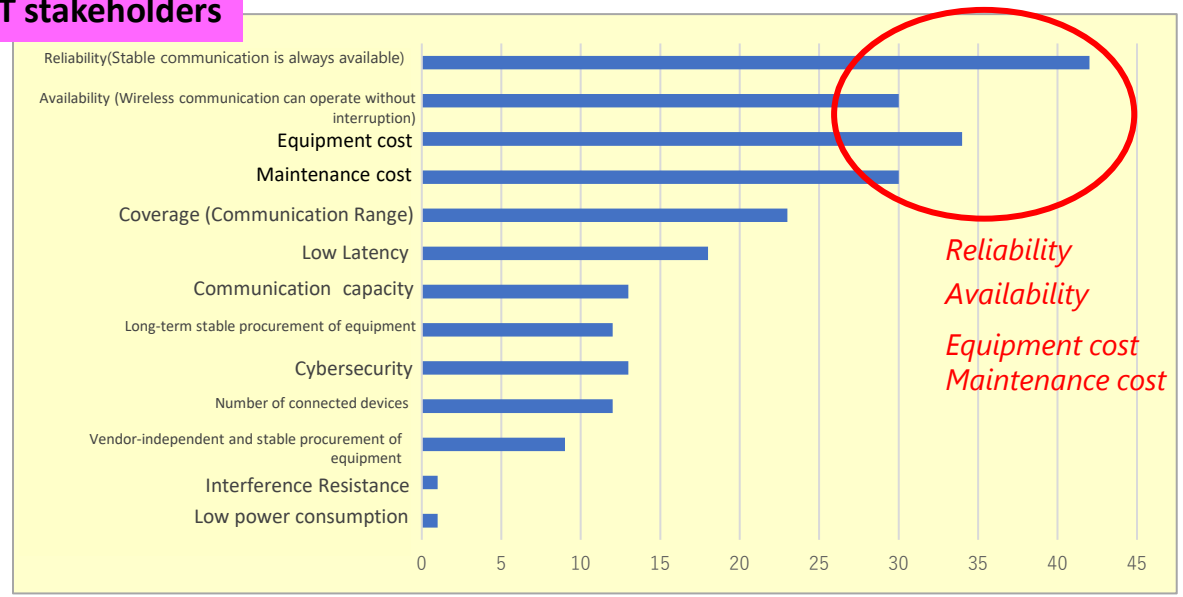


引用：Industrial network market shares 2023

https://www.hms-networks.com/news/news-details/21-05-2023-industrial-network-market-shares-2023

Challenges of wireless communication as you see them

ICT stakeholders



ICT, OT, End-users：The challenges of wireless communication are concentrated around reliability, availability, equipment cost, and maintenance cost.

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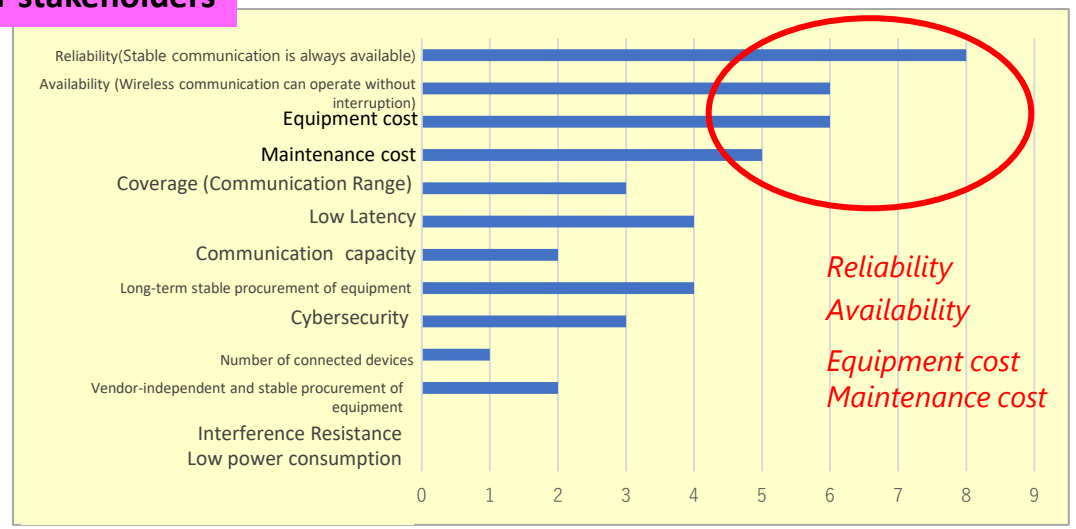
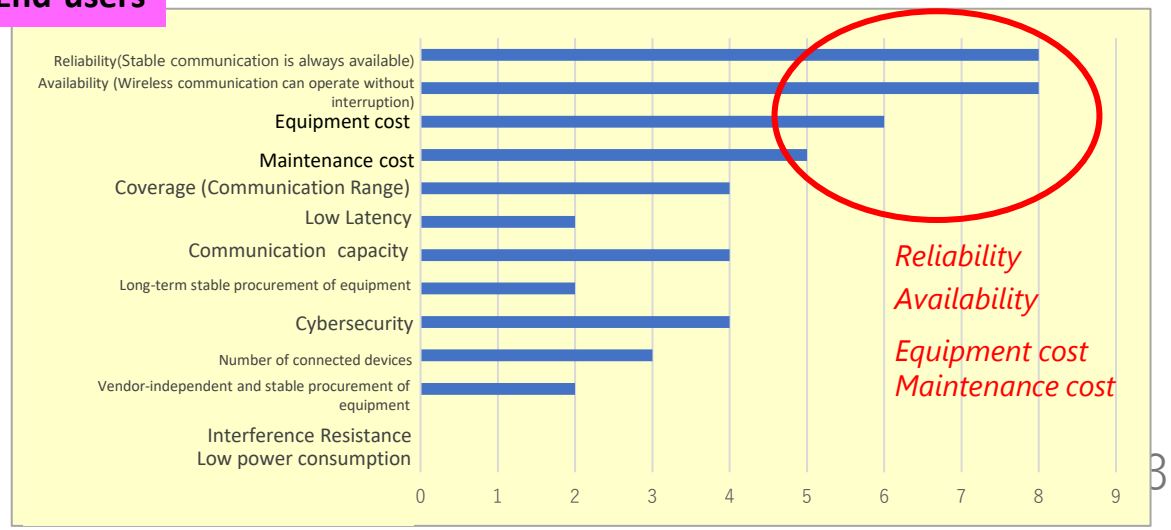
Across the board, the two major issues are the stabilization of wireless communication and its cost.

OT stakeholders

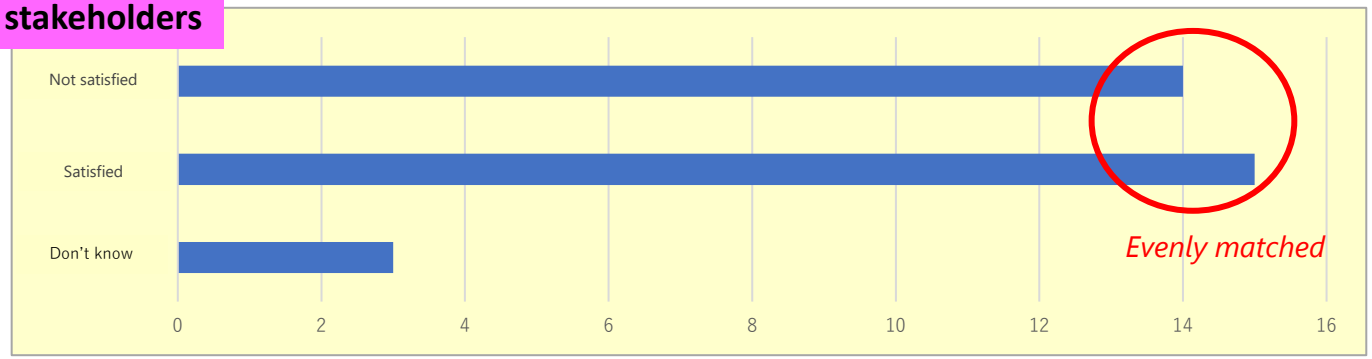


End-users

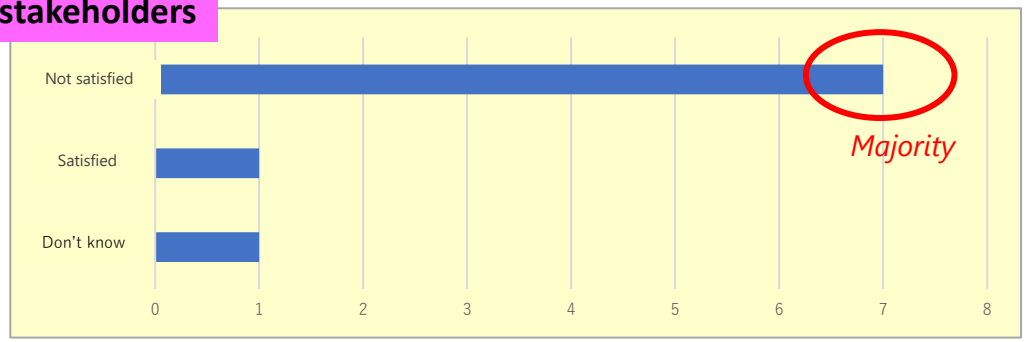


The quality of wireless communication used by your site (end-users) and your customers (vendors)

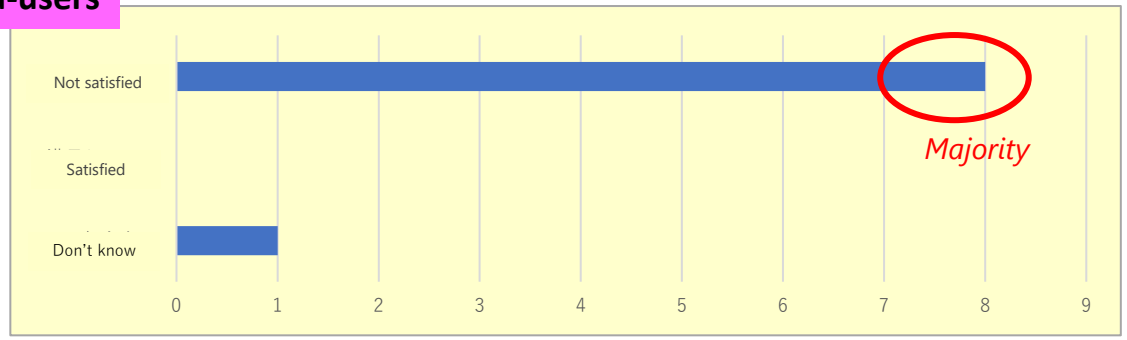
ICT stakeholders



OT stakeholders



End-users



ICT：The number of responses for "satisfied with quality" and "not satisfied with quality" are nearly equal.

OT, End-users：The number of responses for "not satisfied with quality" is significantly higher.

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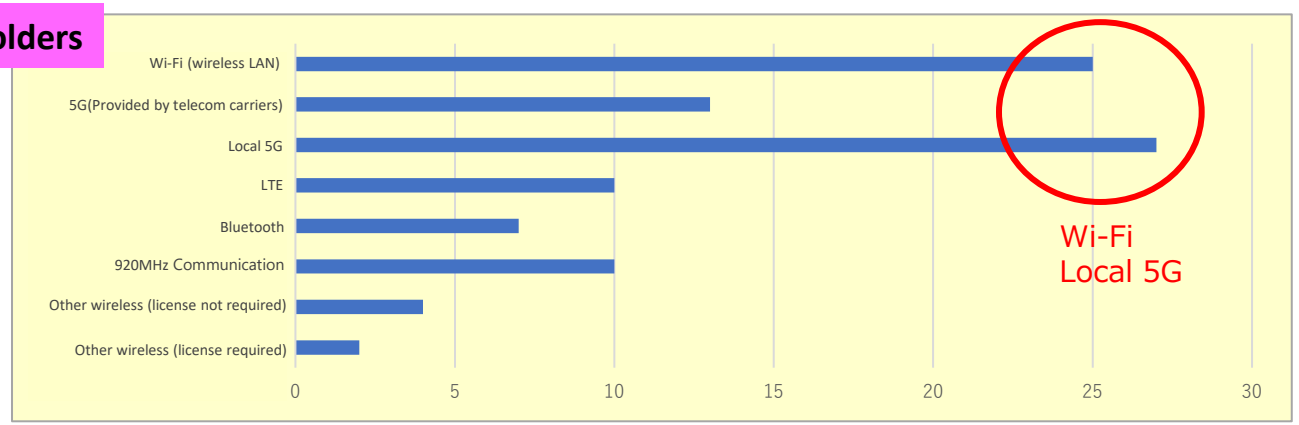
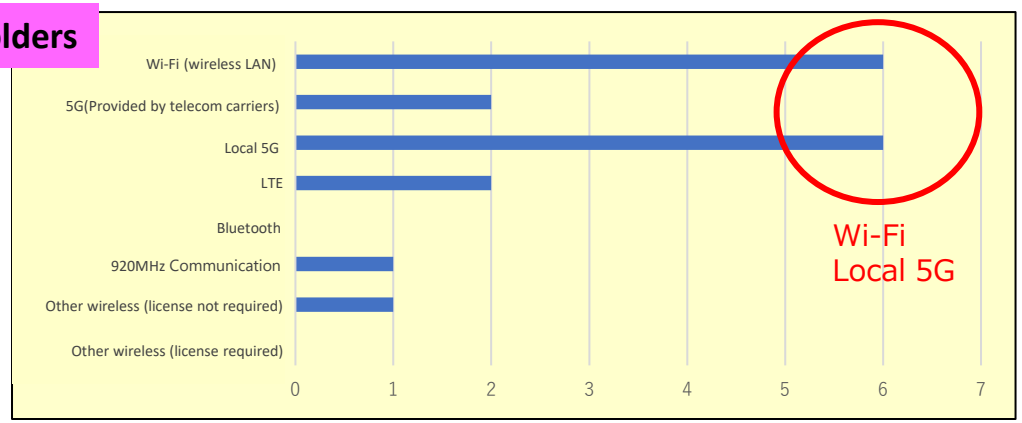
Awareness gap between vendors and users

Over the next three years, the types of wireless communication that will be introduced or updated by your site (end-users) and your customers (vendors)

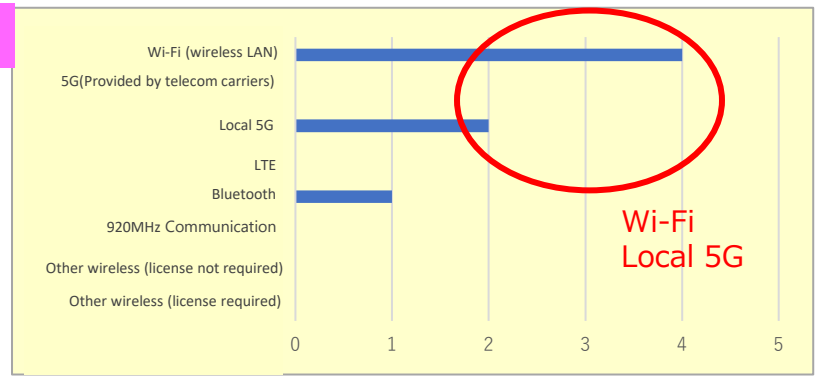
ICT stakeholders



OT stakeholders



End-users



ICT, OT, End-users：Wi-Fi adoption continues, but the introduction of Local 5G is also being considered.

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Full-scale adoption of Local 5G is anticipated

Detailed Analysis by Role (ICT/OT/End-User)

- In the context of utilizing wireless communication, remote monitoring, remote operation, and automated transport are considered effective applications. Additionally, end-users have identified equipment operation and maintenance, environmental monitoring and control, and employee safety management as effective applications. The value of wireless communication can be reasonably defined as "connecting remote, mobile, or distributed entities.“
- Among the types of wireless communication, Wi-Fi (wireless LAN) accounts for a large proportion. However, according to responses from ICT professionals, 5G/local 5G/LTE are also frequently mentioned. On the other hand, in responses from end users, Bluetooth ranks higher than 5G/LTE after Wi-Fi. Since Wi-Fi and Bluetooth are often implemented directly by the field teams themselves, it is likely that their usage is more widespread than vendors are aware of.
- The challenges of wireless communication are concentrated on reliability, availability, device cost, and maintenance cost. The focus is on the actual performance achievable on-site rather than peak performance, and on the running costs, not just the initial implementation costs.
- Regarding satisfaction with wireless communication quality, ICT professionals' responses are evenly split between satisfaction and dissatisfaction. However, OT professionals and end-users predominantly express dissatisfaction. If reliability and availability are the main issues, improving these levels is crucial. Since wireless communication cannot guarantee 100% reliability (similar to wired communication), it is necessary to balance applications with the benefits outweighing the dissatisfaction.
- In the next three years, the types of wireless communication that end-users and vendors (their customers) plan to introduce or update include Wi-Fi and local 5G, as indicated by ICT professionals, OT professionals, and end-users. Despite the many challenges associated with local 5G, the results show promising expectations.

Overall Summary

Overall Considerations and Future Measures:

Regarding expectations and interest in wireless, 5G/local 5G, there are differences based on job roles as follows:

- **End-User < OT < ICT**
    - **Action Needed**: Measures are needed to bridge these gaps and connect them to business opportunities, especially through explanations and demonstrations for end-users.

- Remote monitoring, remote operation, automated transport (and coverage) are highly anticipated. **Focus for 5G**: These applications should be prioritized for 5G. However, other uses expected by end-users/OT should also be considered for the effectiveness of wireless/5G applications. The value of wireless/5G should be considered for more general applications.

- Wi-Fi is already widely used and will continue to be used.
    - **Need for Clear Differentiation:** It is necessary to clearly differentiate and explain the use cases of Wi-Fi and 5G.

- There are issues for significant dissatisfaction, particularly with reliability, availability, device cost, and maintenance cost. **Improvement for 5G**: Efforts should be made to improve reliability and availability for 5G and differentiate it from Wi-Fi. Regarding cost issues, the advantages in terms of cost-effectiveness should be explained through RoI (Return on Investment) analysis.

- The survey received insufficient responses from companies that have implemented or are considering implementing local 5G.
    - **Action Needed:** Active contact and interviews with companies that have implemented or are considering implementing local 5G are necessary. Reflecting on this survey, preparations for re-survey, including methods, are needed.

- Radio licensing issues are of high interest as challenges for providers of local 5G.
    - **Action Needed:** Requests and solution proposals regarding licensing should be carefully examined and compiled, and discussions with the Ministry of Internal Affairs and Communications should be advanced.

【Reference】

Attributes of the survey respondents

Correlation between respondents' industries and job types

全体		Technical Development	Business Development	Research	Sales	Marketing	Production Engineering	Corporate Planning	Executive Management	Education /Research	Production Management
	78	27	19	10	8	6	3	3	1	1	0
Manufacturing	40	16	7	5	4	4	2	2	0	0	0
Information and Communications	24	10	9	2	2	1	0	0	0	0	0
Construction	4	1	1	0	1	0	1	0	0	0	0
Consulting	3	0	0	1	1	0	0	1	0	0	0
Research Institutions	2	0	0	2	0	0	0	0	0	0	0
Transportation	1	0	1	0	0	0	0	0	0	0	0
Services	1	0	0	0	0	0	0	0	1	1	0
Electricity, Gas, Heat Supply, Water Utility	1	0	1	0	0	0	0	0	0	0	0
Educational Institutions	1	0	0	0	0	0	0	0	0	0	0
Sler(mainly for manufacturing)	1	0	0	0	0	1	0	0	0	0	0

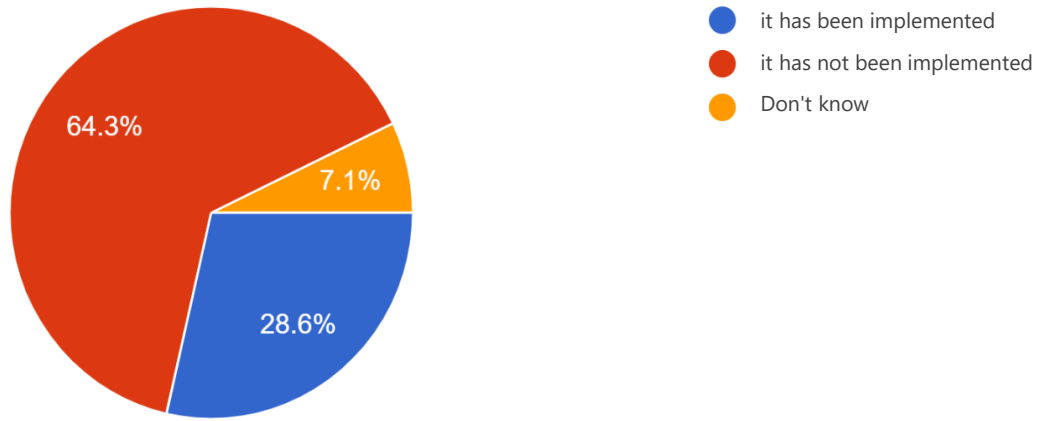
Correlation between respondents' industries and their roles

全体		ICT stakeholder	OT stakeholder	End-User	Infrastructure Development	Implementation Support Consultant	Equipment Provider to Users	Individuals Involved in ICT as a Research Subject	Proposal Activities for Clients Promoting Industrial DX	None of the Above
	78	54	9	9	1	1	1	1	1	1
Manufacturing	40	22	6	9	0	0	1	1	0	1
Information and Communications	24	22	1	0	0	0	0	0	1	0
Construction	4	2	1	0	1	0	0	0	0	0
Consulting	3	2	0	0	0	1	0	0	0	0
Research Institutions	2	2	0	0	0	0	0	0	0	0
Transportation	1	1	0	0	0	0	0	0	0	0
Services	1	1	0	0	0	0	0	0	0	0
Electricity, Gas, Heat Supply, Water Utility	1	1	0	0	0	0	0	0	0	0
Educational Institutions	1	1	0	0	0	0	0	0	0	0
Sier(mainly for manufacturing)	1	0	1	0	0	0	0	0	0	0

Opinions from those in a position to use local 5G

Q.3-1 **Has your company or organization implemented local 5G?**

14 responses



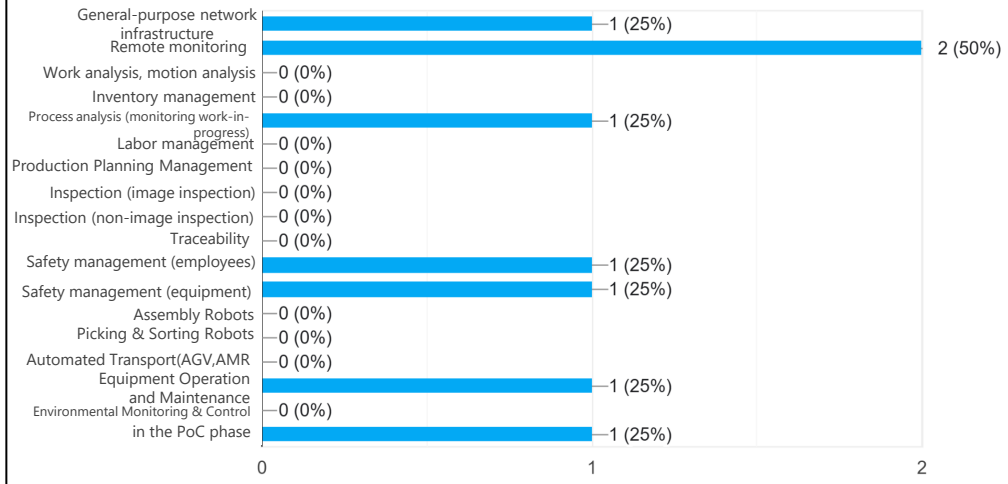
- Since the question was directed at a small number of individuals in a position to use local 5G, the number of responses was limited to 14.
- Even among them, nearly 30% of companies have not introduced local 5G, clearly indicating that the adoption of local 5G is still limited among the three member organizations.

Opinions from those in a position to use local 5G

Opinions from companies or organizations that have implemented local 5G

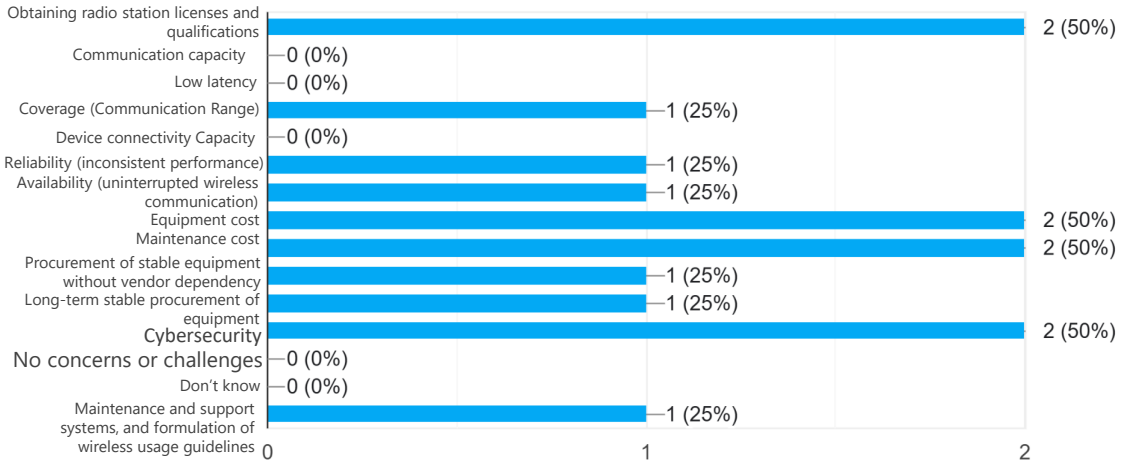
Q.3-2 **What applications are you using the implemented local 5G for?(Multiple answers allowed)**

4 responses



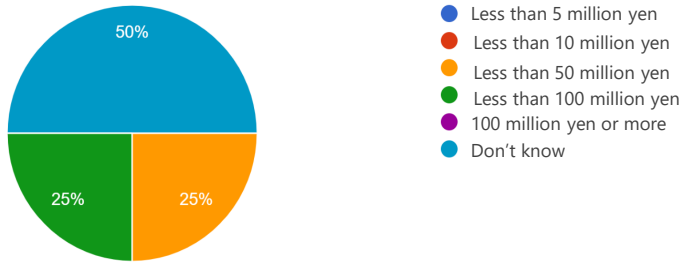
Q.3-3 **What were the challenges or concerns in implementing local 5G?**

4 responses



Q.3-4 **Approximately how much did the total cost of implementing local 5G amount to?**

4 responses



- Since there were only a very small number of responses (4), the opinions of those who have already introduced local 5G could not be sufficiently captured in this survey.
- Although the accuracy is low, the identified challenges include licensing, cost, and security, among others.

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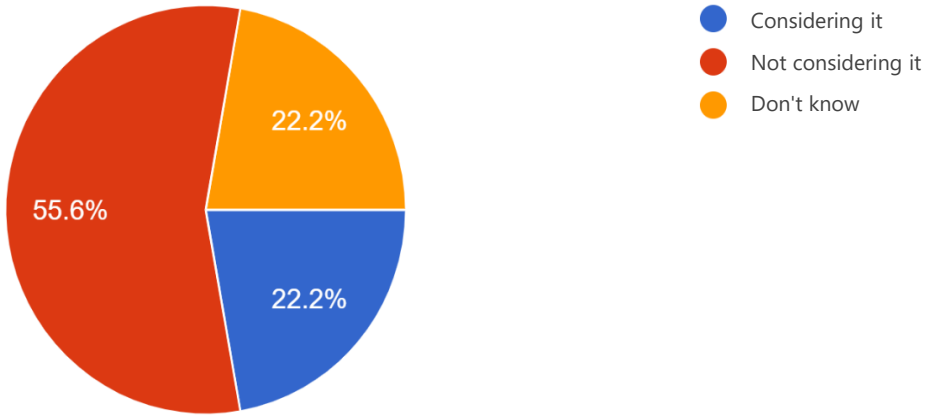
Opinions from those in a position to use local 5G

Opinions from companies or organizations that have not implemented local 5G

Q.3-5

9 responses

Are you considering implementing local 5G?



- More than half of the respondents have not yet entered the stage of considering the introduction of local 5G, clearly indicating the need for future promotional efforts for local 5G.

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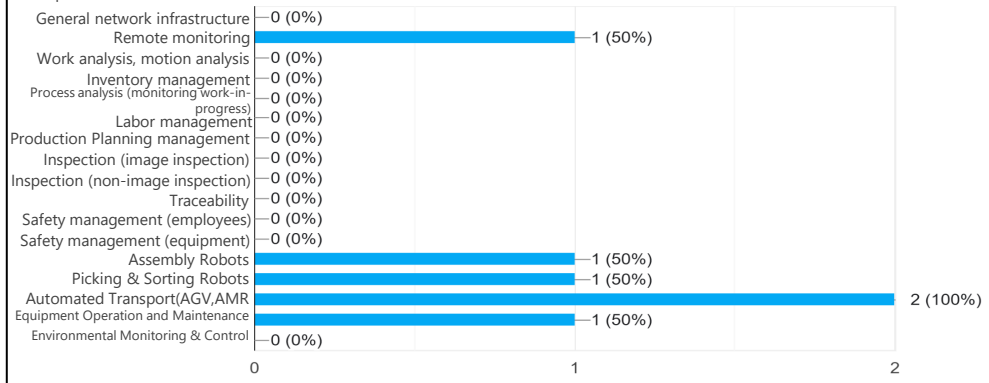
Opinions from those in a position to use local 5G

Opinions from companies or organizations considering implementing local 5G

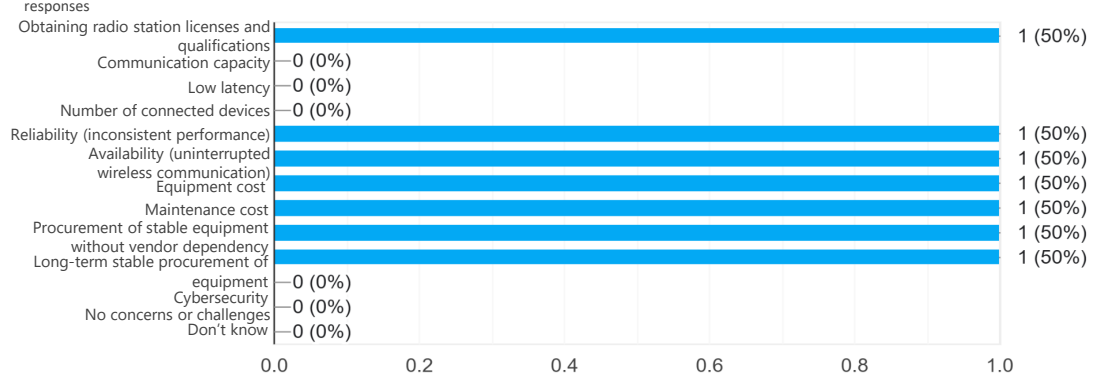
Q.3-6 **What applications are you considering implementing local 5G for? (Multiple answers allowed)**

2 responses



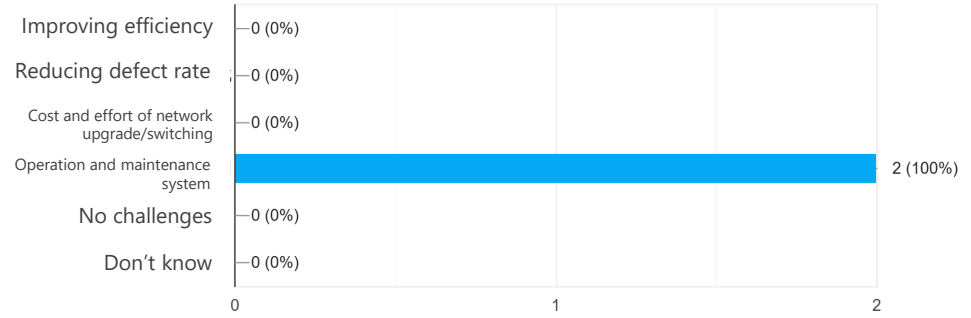
Q.3-7 **What are the challenges or concerns in considering the implementation of local 5G? (Multiple answers allowed)**

2 responses



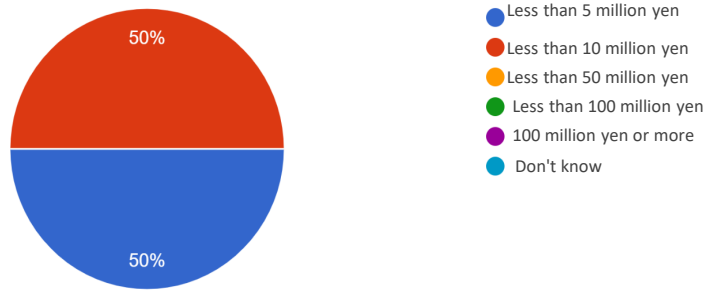
Q.3-8 **What are the business challenges in considering the implementation of local 5G? (Multiple answers allowed)**

2 responses



Q.3-9 **What is the approximate budget for implementing local 5G?**

2 responses



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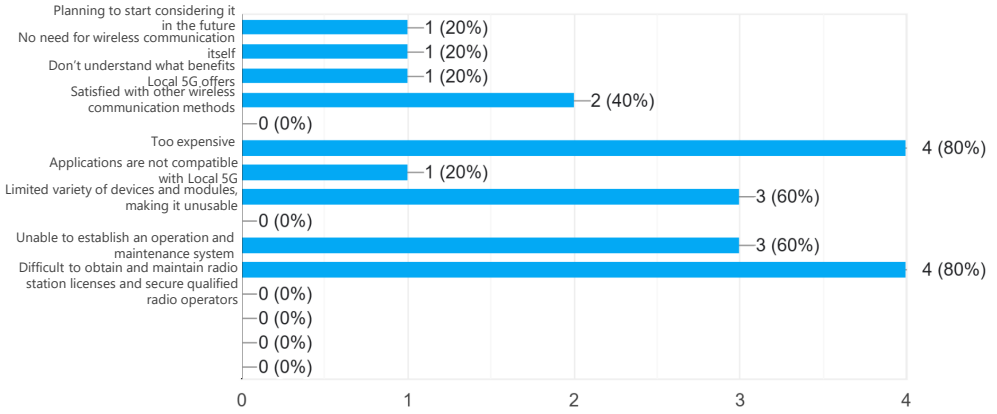
Opinions from those in a position to use local 5G

Opinions from companies or organizations that are not considering implementing of local 5G

Q.3-10
5 responses

What are the reasons for not considering the implementation of local 5G? (Multiple answers allowed)



Q.3-11
5 responses

Have you implemented any communication networks other than local 5G?

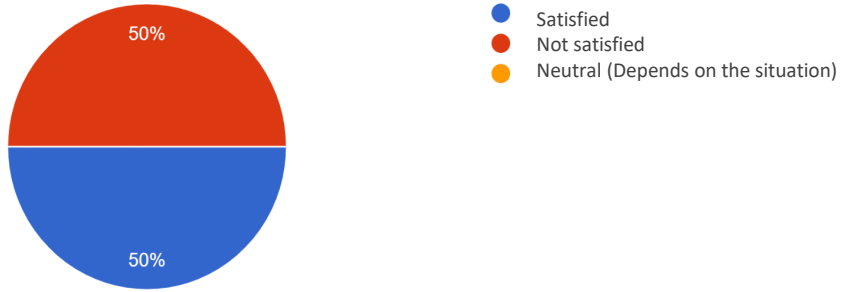
- Reasons for not considering local 5G include cost, radio licensing, types of devices, and maintenance systems, which were relatively common.
- 80% have introduced Wi-Fi.

Opinions from those in a position to use local 5G

Opinions from companies or organizations that are not considering local 5G but have implemented wireless LAN (Wi-Fi)

Q.3-12 **Are you satisfied with the quality of Wi-Fi (wireless LAN)?**

4 responses



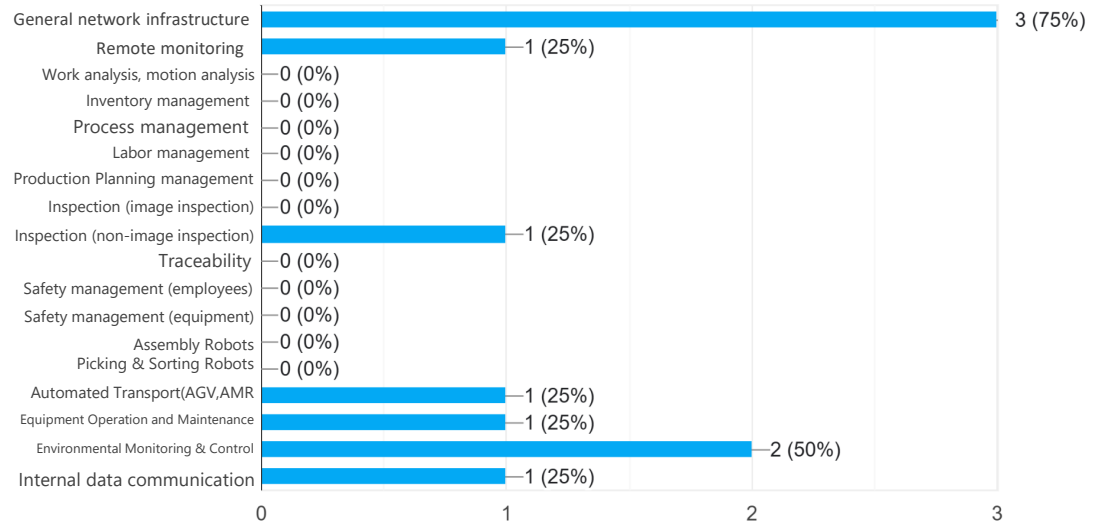
If possible, please explain the reason for your answer

3 responses

- Network administrators are managing it centrally, so there are almost no situations where connections cannot be made or collisions occur.
- Collision and packet loss
- The capacity is not sufficient (cannot handle the increase in the number of terminals to be introduced)

Q.3-13 **What applications are you using Wi-Fi (wireless LAN) for? (Multiple answers allowed)**

4 responses



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Additional Feedback:

If you have any other comments or opinions regarding this survey or the overall utilization of 5G in the manufacturing industry, please let us know.

17 responses

•Cost-Priority Wireless: The adoption of 5G/LSG in manufacturing is still low, so it would be helpful to introduce use cases and cost-effectiveness examples of relatively high-feature wireless measurement devices (PA, civil engineering tests, fluid flow measurement, etc.). It is important to recognize specific examples of 5G utilization.

•End-User Perspective: End-users perceive local 5G as a new technology. When considering full-scale implementation, they are unsure if it is a new technology or how it differs from other technologies. Especially in manufacturing, the differences from existing technologies are unclear, so it is not perceived as a new technology. Information on specific examples and implementation effects is needed.

•Next-Generation Communication Standards: Many companies are no longer considering 5G, so information on next-generation standards, other standards, and new Wi-Fi standards is needed.

•5G Utilization in Manufacturing: There are many examples of 5G utilization in manufacturing, but applications like adapting to plastic molding machines for automotive measures are not prominent. Information on adapting to plastic molding machines and other reactive applications is needed. If there are examples that can be applied to industries other than automotive parts, please provide information.

•I think surveys are important as objective information, but I am concerned that XGMF members may be biased towards the side they want to promote.

•When estimating construction and operational costs, profitability is low, but ultimately it will be taken down due to cost. The price range is also large, and dedicated channels like LTE and 5G cannot avoid interference. It is assumed to be used as a dedicated line for businesses rather than home Wi-Fi. Even if Wi-Fi is used, it cannot be solved by introducing FFFP (because of its high degree of freedom).

•In the case of local 5G, it will be licensed, and we have no choice but to proceed little by little in cooperation with each company.

•Especially in the case of local 5G, there are many issues such as antenna installation locations and signal strength.

•Since 5G places a heavy burden on base stations, the cost will also increase accordingly. Therefore, at present, it can only be used in limited places such as commercial facilities.

•As a user, I look forward to the full-scale spread of 5G.

•In order to further popularize local 5G, it is necessary to clearly define the value proposition and cost benefits in user cases for end users.

•There are mainly three understandings of the necessity of 5G, and a mechanism to support its introduction is needed.

•Examples that include things that can only be realized with 5G are very critical use cases. Although there are challenges in large-scale outdoor coverage, if it is indoors such as in factories or warehouses, it may be possible to provide a more stable communication environment than WiFi. Especially in the manufacturing industry, it is expected that real-time data will be collected from machines and equipment operating within factories and used to improve production efficiency and quality. Additionally, in the logistics industry, it is utilized for product management and inventory management within warehouses, providing high-precision services through Wi-Fi and 5G systems.

•From the perspective of the licensing system and the flexibility of device procurement (terminals), these are also important.

•To proceed with the actual consideration and service provision of use cases and possible solutions, collaboration and cooperation with many stakeholders are essential.

•Strategies, system construction, and operational methods should be carefully considered based on these points.