Reducing Ambiguity in Requirements through Multi-modal Communication

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Abstract

In an era where software development is accelerating at unprecedented rates, clear and concise communication of requirements has never been more critical. Yet, businesses continue to grapple with the challenge of effectively conveying requirements to their software development teams. The consequences? Misinterpretation, rework, inflated costs, and missed deadlines.

Enter the realm of multi-modal communication; a game-changing approach to requirements communication that leverages various forms of communication mediums to ensure clarity and reduce ambiguity. This talk will explore this innovative strategy, which has been successfully adopted by forward-thinking organizations worldwide.

Unlike traditional methods that rely heavily on written documentation, multi-modal communication employs a combination of visual, verbal, and written mediums. It taps into the power of diagrams, prototypes, and face-to-face discussions, fostering a deeper understanding and alignment between business stakeholders, the developers, and the quality assurance team.

In this paper, you will discover how this approach can significantly minimize the risks associated with unclear communication, such as scope creep, budget overruns, and project failure. In addition, I will explore how multi-modal communication can lead to more accurate requirement interpretation, faster development cycles, and ultimately, high-quality software products that meet users' needs.

The associated talk will provide practical tips and techniques for implementing multi-modal communication in your own organization, regardless of its size or the complexity of its projects. From leveraging visual aids to promoting active listening, we'll delve into strategies that can transform your requirements gathering and communication processes.

Biography

Evan Masters is passionate about seeing customers succeed. With over 10 years' experience in the software quality assurance industry, Evan has helped companies around the globe overcome challenges and implement innovative new technologies in support of business goals and objectives. Working with companies of all sizes, from startups to Fortune 5 companies, and thriving on his ability to listen to and understand customers' real needs, he has equipped and supported teams with the tools necessary to take their capabilities to the next level.

1 Introduction

1.1 Overview of the current landscape of software development as it pertains to the subject matter.

To meet the ever-increasing demands of delivering high quality software products and solutions at a pace matching rapidly evolving business needs, Software Quality Assurance (SQA) professionals need to leverage every resource at their disposal. An effective strategy SQA professionals can employ to ensure the quality of the product or solution is to engage with stakeholders at every stage of the SDLC, not just the Testing stage. A tool that can be used to implement this strategy is a diagram of their understanding of the intended behavior of the business system. This helps to prevent any misalignment in the understanding of the intended behavior across the various stakeholder groups.

Creating (good) models and diagrams to augment text-based definitions of the desired system offers many benefits which I will discuss in depth throughout this work. Creating models and diagrams allows SQA professionals to become engaged much sooner in the SDLC than typically realized, putting quality front and center from the start of the process. These models and diagrams give the SQA professionals a layer of abstraction that can be used to convey an understanding of the system being developed in a way that stakeholders of any technical or business level of expertise can understand.

Whether your project follows traditional linear development methodologies, such as Waterfall, or the more contemporary (and these days more common) iterative methodologies, such as those that fall into the Agile category, you can benefit from engaging in multi-modal communication via requirement/story visualizations using models.

1.2 Challenges faced by business stakeholders in effectively conveying requirements to software development teams.

Business stakeholders, such as Business Analysts (BAs), are typically responsible for describing what the business solution should do to satisfy a need. When they undertake this task, they have a goal to describe the intended behavior as clearly as possible so that the development team can understand what is being asked of them. However, these business stakeholders face several challenges in effectively conveying these requirements to the development teams. These challenges include:

- **Organization structure challenges (i.e., silos):** It is not at all uncommon for business organizations to be functionally segregated. Sometimes there are good business reasons for this. One downside to such an organizational structure is that it prevents the people on these segregated (i.e., siloed) teams from seeing the bigger picture. Therefore, when one of them attempts to describe a business need, they can't see the full impact of how the solution will affect the organization as a whole.
- **Lack of a full understanding of the need:** Another common shortcoming that business stakeholders face when attempting to describe a business need is that they don't fully understand it. This isn't meant as a slight or criticism about these stakeholders. On the contrary, I have personally found myself in this situation numerous times. Rather, it's an acceptance of the fact that business stakeholders often find themselves faced with a problem of finite resources. The resources could be time, accessibility to Subject Matter Experts (SME's), technical expertise, overwhelming amounts of context around the need, just to name a few.
- **Not experienced with conveying the business need to technical resources:** Even the best-intentioned business stakeholders may have a hard time conveying their need in ways that a development team could take and turn into something deliverable. While this does get easier with experience, additional complications to this can arise for even experienced authors. Complications such as offshore teams, infrastructure considerations and constraints, and complex system interactions. Each of these complications adds a layer of difficulty the business stakeholder will have to contend with to convey their need.

In any case, whenever a business stakeholder is unable to completely convey all aspects of a business need to the technical resources that will be developing and testing the solution, they have created ***ambiguous*** requirements. The next section will explore the implications of this result.

2 The Impact of Ambiguous Requirements

2.1 Consequences of ambiguous requirements

Cutting right to the point, the biggest consequence of a business stakeholder creating ambiguous requirements is cost; specifically, increased cost. Whenever ambiguous requirements are used as input to create something designed to serve a business need, it costs more than it would if the definition were clear and unambiguous from the start. This increased cost can come from:

- **An increased number of communication feedback loops:** This happens when the business stakeholder communicates either directly or asynchronously with the development team to clarify their intent. In essence, the more meetings or more email chains that must happen as part of the development process, the more expensive the development is.
- **Rework:** This occurs when the development team interprets what the business stakeholder gave them as input without getting full clarification. The result of this can be a pattern of the developer presenting the solution they've built and including the question, "Is this it?". The longer the development cycle, and the more of the solution built and delivered before showing the stakeholder, the greater the risk of a large amount of required rework.
- **Opportunity costs:** Opportunity costs can occur when the product being delivered contributes to revenue generation. The longer the product is 'in-house' and not in the marketplace, the more time passes without revenue coming in from the product. The other opportunity cost to consider is that the longer the development team spends on a project, the more time passes before they are available to work on the next project. The next project could be either a revenue generator or a cost-saver. Either of which would have a direct cost impact.

There are, of course, other consequences of ambiguous requirements that are not directly cost related.

- **Missed deadlines:** One clear impact of having unclear/ambiguous specs is that it will take longer for the development team to create the proposed solution. If this isn't considered when project timelines are developed (and it almost certainly is not), then there runs the very real risk that any deadlines that have been set are in jeopardy of being missed. While there certainly can be a direct impact to cost when a deadline is missed, I chose to include this consequence as an indirect cost. I did so based on the experience that I have both as a member of an SQA team that been on the receiving end of such a situation, and as a higher-level consultant observing members of my hosting organization's SQA group. What happens more often than not is that the time is made up at the typical end of the SDLC process; namely, it stretches the SQA team. This can result in extra hours worked for the SQA team, a reduction in the amount of valuable quality assurance tasks that can be undertaken, or both.
- **Technical debt**: Technical debt is the implied cost of future work that must occur in response to implementing a solution that is not the best long-term solution, but it works sufficiently in the short term. An analogy for technical debt from the physical world is as follows. Imagine that you are having a home built. You can choose to use materials that are high-quality, recommended by various industry experts, and cost more. By doing so, your home will be more resilient over time, cost less to maintain, and will likely pass any sort of required inspection. Alternatively, you could choose to go with building materials that are lower-quality, acceptable to various industry experts (though not recommended), and initially cost less. The result of which is a home that will end up being less resilient over time, cost more to maintain, and dubiously pass inspections. The latter choice is analogous to choosing the easier and less desirable software implementation option and incurring technical debt.
- **Erosion of trust and confidence:** In less concrete terms, if business stakeholders were to consistently produce ambiguous requirements to the development team and expect them to in

turn deliver perfect software that meets their every need, only to turn around and be frustrated with the development team when the delivery falls short (through no fault of the hard working dev team), an attitude shift will undoubtedly happen over time. The dev team would come to expect that no matter how hard they work and how many extra hours they put in to meet the business-defined deadlines, their work will likely be rejected, and they will have to 'open the hood', sometimes multiple times, before their deliverable is accepted. In turn, the business stakeholders will come to expect that whatever the dev teams show them first, it won't be right, and they will have to go through multiple rounds before they get software that meets their needs. This erosion of confidence by both groups in their counterparts can, in the extreme, become adversarial, and in less extreme circumstances lead to less productive work by both teams.

3 Introduction to Multi-modal Communication

3.1 Explanation of multi-modal communication as an approach to requirements communication.

What is Multi-modal communication? In short, it can be described as expanding the way something is communicated to more than just one method. For example, most software specs are authored in a text-based communication mode, and only a test-based communication mode. Think of user stories. These are authored in some kind of management system and are primarily written down in a text field. If one were to augment this with, let's say a wireframe or mockup, a second type of communication mode has been introduced. This makes it a multi-modal communication mode.

Multimodal communication is the use of multiple modes of communication to convey a message. This can include verbal language, written language, images, sounds, and gestures. Some of these modes are easy to capture and codify to make a persistent record. Other are more ephemeral, though that does not necessarily reduce the importance or effectiveness of the mode.

Multimodal communication can be used to improve the clarity and understanding of a message by providing different ways for the receiver to interpret it. By providing multiple different communication modes that describe the solution, there is a much greater likelihood that the stakeholders will have a complete understanding of the intendent behavior of the system.

In the context of requirements communication, multimodal communication can be used to:

- Ensure that all stakeholders have a shared understanding of the requirements.
- Reduce ambiguity and misinterpretations.
- Make the requirements more accessible to a wider range of stakeholders.

3.2 Exploration of how it can ensure clarity, reduce ambiguity, and create a common understanding of the intended requirements.

Multimodal communication can help to ensure clarity by providing different ways for the receiver to interpret the message. For example, a written description of a requirement can be supplemented with images, diagrams, or videos to help the receiver visualize the requirement.

Multimodal communication can also help to reduce ambiguity by providing multiple perspectives on the same message. For example, a requirement can be described in different ways, such as in natural language, formal language, or graphical form. This can help to ensure that all stakeholders have a shared understanding of the requirement. To illustrate this, consider the following example:

On Monday, you tell your boss that you will be meeting with your customer next Thursday. He interprets this to be the next Thursday on the calendar, three days from Monday. What it meant to you and the customer was the Thursday the following week. The use of informal language has resulted in an ambiguity.

Formal language can be used here to precisely define that by “next Thursday”, you mean Thursday, September 14th, 2023”. This multi-modal communication has eliminated any possible ambiguity.

Finally, multimodal communication can make the requirements more accessible to a wider range of stakeholders. For example, people with different language skills or learning styles may be able to better understand the requirements if they are presented in multiple modes. Some stakeholders may be visual learners who best understand things presented in picture or graphical format, while others may be more apt to consume information presented in a bulleted list or If/Then format. By providing both, you are increasing the approachability of your design to a broader audience.

Here are some specific examples of how multimodal communication can be used to improve requirements communication:

- A requirements document can include:
    - A written description of the requirements.
    - Diagrams or illustrations of the requirements.
    - Use cases or scenarios that illustrate how the requirements will be used.
    - Screen mockups or prototypes of the user interface.
- Requirements can be gathered through interviews, workshops, or focus groups, and these sessions can be recorded and transcribed to capture the different ways that stakeholders communicate about the requirements.
- Requirements can be modeled using UML or other modeling languages, which can help to visualize the requirements and identify potential ambiguities.
- Requirements can be tested using a variety of techniques, such as user testing or acceptance testing, to ensure that they are understood and can be implemented correctly.

By using multimodal communication, you can be sure that that the requirements are clear, unambiguous, and understood by all stakeholders. This can help to avoid costly rework that leads to delays and frustrations.

4 Success Stories: Multi-modal Communication in Practice

4.1 Case Studies of how multi-modal communication has helped organizations of all sizes, in various industries, and around the globe achieve higher quality business systems.

I have a number of case studies that show how engaging in Multi-Modal Communication has resulted in major successes for the customer. These are available on the Critical Logic website here. Additional whitepapers can found here.

5 Multi-modal Communication Versus Traditional Methods

5.1 Comparison of multi-modal communication with traditional methods that rely heavily on written documentation.

Traditional methods of requirements communication rely heavily on written documentation. This can be effective in some cases, but it can also lead to ambiguity and misunderstandings. The word ‘biweekly’ for example is inherently ambiguous. Dictionary.com defines ‘biweekly’ as both twice a week and every other week. There are many more examples like this in the English language, and likely in other languages as well.

Multimodal communication, on the other hand, uses multiple modes of communication to convey a message. This can help to improve clarity and understanding by providing different ways for the receiver to interpret the message. Imagine visualizing your intent of the word ‘biweekly’ by showing an image of a monthly calendar with every other Tuesday highlighted. This clearly shows your intent of the meaning of ‘biweekly’.

Some of the benefits of using multimodal communication over traditional methods include:

- Increased clarity and understanding of the requirements.
- Reduced ambiguity and misinterpretations.
- Improved accessibility of the requirements to a wider range of stakeholders.
- Increased engagement of stakeholders in the requirements definition process.

5.2 How multi-modal communication resets the standards for communication between all participants in the SDLC.

Multimodal communication can reset the standards for communication between all participants in the SDLC by:

- Ensuring that all stakeholders have a common understanding of the requirements.
- Facilitating communication between stakeholders with different language skills or learning styles.
- Making the requirements more accessible to stakeholders with disabilities.
- Improving the efficiency and effectiveness of the requirement development and communication process.

Overall, multimodal communication is a more effective way to communicate requirements than traditional methods that rely heavily on written documentation. By using multimodal communication, you can help to ensure that the requirements are clear, unambiguous, and understood by all stakeholders. This can help to avoid costly rework and delays in the development process.

Here are some specific examples of how multimodal communication can be used in the SDLC:

- During the requirements gathering phase
    - Stakeholder interviews can be recorded and transcribed to capture the different ways that stakeholders communicate about the requirements.
    - Requirements workshops can be used to facilitate communication between stakeholders and to get feedback on the requirements.
    - Use cases or scenarios can be used to illustrate how the requirements will be used.
    - Diagrams can be created based on Use Cases and/or Scenarios that augment the information contained in the Use Case/Scenario.

During the requirements analysis phase:

- Requirements can be modeled using UML or other modeling languages to visualize the requirements and identify potential ambiguities.
- Requirements can be modeled using a variety of techniques, and then shared back with the stakeholders who originated the requirements to ensure that they are understood and can be implemented correctly.

During the requirements validation phase:

- The requirements can be presented to stakeholders in multiple formats, such as written documents, diagrams, or prototypes, to ensure that they are understood.
- Stakeholders can be asked to provide feedback on the requirements in multiple formats.
- Tests can be developed from the visualized requirements and included in the validation assets so stakeholders know how their requirements will be validated.

By using multimodal communication throughout the SDLC, you can help to ensure that the requirements are clear, unambiguous, and understood by all stakeholders. This can help to avoid costly rework and delays in the development process.

6 The Benefits of Multi-modal Communication

6.1 Explanation of how this approach minimizes risks associated with unclear communication.

Multimodal communication can help to minimize the risks associated with unclear communication by providing multiple ways for the receiver to interpret the message. This can help to avoid misunderstandings and misinterpretations.

For example, a written description of a requirement can be supplemented with images, diagrams, or videos to help the receiver visualize the requirement. This can be especially helpful for stakeholders who have different learning styles or who are not native speakers of the language in which the requirements are written.

This will also lead to more accurate requirement interpretation. Specifically, Multimodal communication can lead to more accurate requirement interpretation by providing different perspectives on the same message. This can help to ensure that all stakeholders have a common understanding of the requirement. For example, a requirement can be described in different ways, such as in natural language, formal language, and graphical form. By doing so, this can help to ensure that all stakeholders are able to understand the requirement, regardless of their background or preferences.

Resulting in faster development cycles

Multimodal communication can result in faster development cycles by reducing the need for rework. When requirements are clear and unambiguous, there is less need to go back and forth between stakeholders to clarify the meaning of the requirements. This can save time and money in the long run.

Producing higher quality business systems

Multimodal communication can produce higher quality business systems by ensuring that the requirements are accurately implemented. When requirements are clear and unambiguous, there is less risk of errors being introduced into the system during the development process. This can lead to a higher quality system that meets the needs of the stakeholders.

In addition to these benefits, multimodal communication can also help to improve the engagement of stakeholders in the requirements definition process. When stakeholders are able to communicate their

needs in a way that is comfortable for them, they are more likely to be engaged in the process and to provide valuable feedback. This can lead to a better understanding of the requirements and to a more successful project overall. By engaging in Multi-Modal communication, you are addressing both the concrete, hard requirement of developing something implementable and testable, and also the softer, more nuanced requirement of allowing all stakeholders, regardless of their specific style, to better and more effectively contribute to the development of the desired solution.

6.2 Discussion on how multi-modal communication can lead to more accurate requirement interpretation, faster development cycles, and higher quality business systems.

Images and diagrams can be a helpful way to illustrate requirements and to make them more understandable. For example, a diagram can be used to show the flow of information through a system. Another type of diagram can be used to show, for the same system, how data elements of a system relate to each other.

Video can be a helpful way to demonstrate how requirements will be used in practice. For example, a video can be used to show a user interacting with a system or to demonstrate how a process will be carried out. Videos can include everything from stakeholder interviews to a demonstration of how an app will function based on a series of mockups.

Prototypes can be used to test requirements and to get feedback from stakeholders. For example, a prototype of a user interface can be used to get feedback on the usability of the interface. Prototypes are also effective for validating accessibility considerations before development.

By using multimodal communication, you can help to ensure that the requirements are clear, unambiguous, and understood by all stakeholders. This can help to avoid costly rework and delays in the development process. It can also lead to higher quality business systems that meet the needs of the stakeholders.

7 Practical Tips and Techniques for Implementing Multi-modal Communication in Organizations

7.1 Guidance on implementing multi-modal communication derived from real-world experience.

In my personal experience, there is a short list of things that you can do to improve you ability to get higher quality requirements from stakeholders by using Multi-modal Communication techniques.

- Identify the stakeholders
    - The first step is to identify the different stakeholders who will be involved in the project. This includes the users of the system, the business owners, the developers, and the testers.
    - This seems obvious but I’ve seen many projects fail because key resources have failed to identify critical stakeholders.
- Understand the needs of the stakeholders
    - Once you have identified the stakeholders, you need to understand their needs and expectations. This includes their understanding of the requirements, their preferred communication methods, and their level of technical expertise.
- Choose the right communication methods
    - Once you understand the needs of the stakeholders, you can choose the right communication methods. This may include written documents, diagrams, videos, prototypes, or even face-to-face meetings.

    - Remember to keep in mind that you may need different communication modes to convey the same message to different stakeholders
- Use multiple communication methods
    - It is important to use multiple communication methods to ensure that all stakeholders can understand the requirements. This is especially important for stakeholders with different learning styles or who are not native speakers of the language in which the requirements are written.
    - Again, multiple modes may need to be implemented.
- Be flexible and reactive
    - It is important to be flexible in your approach to multimodal communication. The best communication method for one stakeholder may not be the best method for another. Be willing to adapt your approach based on the needs of the stakeholders.
- Get feedback
    - It is important to get feedback from the stakeholders throughout the process. This will help you to ensure that the communication is effective and that the requirements are understood.
- Continuously improve
    - The process of multimodal communication is an ongoing process. As you learn more about the stakeholders and their needs, you may need to adjust your approach. Be willing to continuously improve your communication methods to ensure that the requirements are communicated effectively.

8 Conclusion

8.1 Recap and final thoughts

In conclusion, there are a number of significant benefits to employing multiple modes of communication when defining the requirements that define the intended behavior of your business system. Too often, “process” gets in the way of doing what needs to be done to achieve true quality.

Stepping back to remember that all stakeholders are unique individuals with distinct styles will help to keep perspective in mind. Done intentionally, Multi-Modal Communication will greatly improve the chance that you satisfy your stakeholders’ communication preferences and thereby greatly improve the outcome of developing the software that truly meets the needs of the business end user.

You’re on the same team as your stakeholders. Use Multi-Modal Communication to give them what they need to help you help them. You’ll end up with the best product in the end.