FIRST CONSULTING CASE STUDY | TECHNICAL WRITING

Engineer-Led Technical Documentation for a Next-Generation Rail Yard Locomotive Control Radio

PART 1

The Engagement at a Glance

Executive Summary

A global industrial technology manufacturer was bringing a new generation of its radio system for remote control locomotive operations to market. The system links the portable control units carried by rail yard operators with control units on board locomotives, so one or two people on the ground can move locomotives around a freight yard. The new generation had to stay compatible with radios already in service while adding new capabilities, and it needed documentation that customers, installers, and field technicians could rely on.

In August 2023, the client engaged First Consulting to provide a technical writer for the program. Rather than a writer from a general documentation background, First Consulting proposed a senior engineer with decades of embedded and real-time software experience, including more than ten years developing software for networked tactical radios, and a long record of writing manuals for products she had helped build. She was available immediately, worked part time on a time-and-materials basis, and came on site as the work required, with First Consulting management oversight provided at no charge.

The biggest obstacle was that most of the knowledge needed for the manuals was not written down anywhere; it lived in the engineers' heads. The writer ran an extensive, proactive program of engineer interviews to draw that knowledge out. Within the planned three months, she delivered the system's user manual and service manual, and the client approved both.

Background and Context

The client

The client is a global industrial technology manufacturer whose communications business has supplied rugged wireless equipment to railroads and other critical-infrastructure operators for decades. Its rail radios are used by large North American freight railroads.

The product

Remote control locomotive systems are used in freight rail switching yards. An operator on the ground carries a portable control unit and sends commands by radio to a control unit on the locomotive, which runs the throttle and brakes and reports the locomotive's status back. The radio link is the heart of the system: commands have to arrive reliably and in time, across a busy yard with many locomotives operating at once.

The new product generation was built on the client's current radio platform and covered every radio in the system. The table below summarizes what the documentation had to describe.

System element	What it does
Operator control radio	The radio built into the portable control unit carried by the yard operator
Locomotive control radio	The radio on board the locomotive, connected to the locomotive control equipment
Yard repeaters	Fixed infrastructure that extends coverage across the yard, so the operator does not need to stay close to the locomotive
Gateway	Connects the radio system to other yard systems
Backward compatibility	Operation alongside the previous generation of radios already installed in yards
New connectivity	Cellular connectivity for applications outside the yard and for remote access

System elements covered by the documentation.

Why the documentation mattered

Documentation for this kind of product is not a formality. Railroads, system integrators, and the manufacturers of locomotive control equipment use it to install, configure, and maintain radios that carry commands to moving locomotives. It has to be technically exact, it has to be usable by field technicians as well as engineers, and it has to explain how the new generation works alongside the radios already in the field.

- **Rail safety:** remote control locomotive operations are subject to federal railroad safety oversight and to railroad operating rules, so equipment documentation has to support safe, correct installation and use
- **Industry standards:** the radio communications follow a rail industry standard shared with other suppliers' control equipment, so interfaces have to be described precisely for integrators
- **Radio licensing:** the radios operate in licensed spectrum under Federal Communications Commission rules, which the documentation has to reflect in configuration and installation guidance

Scope of the engagement

- **User manual:** how to set up and use the system
- **Service manual:** how to install, configure, maintain, and troubleshoot the radios
- **Knowledge capture:** gathering information directly from the engineering team through interviews, and from the product itself
- **Review and revision:** incorporating engineering and product management review into each document
- **Program oversight:** First Consulting management oversight, provided at no charge to the client

Key Challenges

- **A technically demanding product:** real-time messaging, shared radio channels, repeaters, and interfaces to other manufacturers' equipment meant a writer without an engineering background would need constant explanation and would still risk errors
- **Undocumented knowledge:** most of what the manuals needed to say had never been written down and was known only to the engineers who designed the radios
- **Engineers focused on release:** the engineers who held that knowledge were busy bringing the product to release, so every hour spent explaining it or correcting drafts came out of development
- **A new generation alongside the old:** the manuals had to explain the new features and operation alongside previous-generation radios without confusing readers who knew the earlier product
- **Several audiences:** the people who operate and manage the system need different information, at a different level of detail, from the technicians who install and repair it
- **What was at stake:** unclear or incorrect documentation could cause installation errors and support calls and affect safe operation, and late documentation would hold up the product release

Is This Relevant to You?

First Consulting's approach fits organizations facing any of the following:

- A product release that needs documentation, without enough engineering time to support a writer
- Product knowledge that lives with the engineers rather than in written specifications
- A complex embedded, communications, or control product that general technical writers struggle to describe
- A new product generation that must be documented alongside equipment already in the field
- A short-term or part-time documentation need that does not justify a full-time hire

To discuss a technical writing or documentation need, contact First Consulting.

> **Continue to Part 2 for the details.** Part 2 covers the constraints the work had to fit within, the challenges it had to overcome, the documentation objectives, the writer's background and methodology, execution and results, lessons learned, and why this approach matters.

PART 2

Inside the Engagement

This part goes deeper into the engagement: the constraints it worked within, what made it difficult, how the work was staffed and carried out, and what it delivered.

Engagement Setup

Constraints

- **Part-time effort:** the engagement was scoped at 20 hours a week, so the writing had to be efficient and well organized
- **A product still in development:** the documentation was written while the product was being finished, so content had to keep pace with design changes
- **Engineering time:** the subject matter experts were the same engineers working to release the product, so time with them was limited
- **Fixed window:** the engagement was planned for three months, and both manuals had to be finished within it

How the engagement was awarded

First Consulting responded to the client's request for a technical writer with a single, carefully matched candidate, together with her resume and an example manual she had written on her own initiative, so the client could judge the quality of her writing before engaging her. The candidate's combination of radio software experience and documentation experience meant she could start immediately and needed little time to learn the product.

The Challenge

Writing good documentation for a complex embedded product requires two skills that rarely come together: understanding the technology deeply enough to describe it correctly, and writing clearly enough that someone else can use it in the field.

A technically demanding product

A remote control locomotive radio system involves real-time messaging, shared radio channels, repeaters, network configuration, and interfaces to other manufacturers' control equipment. A writer without an engineering background would need extensive explanations from the engineering team for every topic, and would still risk describing things incorrectly.

Knowledge that existed only in the engineers' heads

This was the central difficulty. Most of what the manuals needed to say had never been written down. How the radios were meant to be set up, used, and serviced was known to the engineers who designed them, but it was not captured in specifications or other documents a writer could work from. The only way to get it was to get it from the engineers themselves.

Engineers focused on release

Those same engineers were busy bringing the product to release. They would not volunteer information on their own, and every hour spent explaining the product, or correcting a draft, was an hour taken from development. The writer had to go after the information, ask the right questions the first time, and produce drafts that needed little correction.

A new generation alongside the old

The new radios had to work in yards where previous-generation radios were still installed, while adding new capabilities. The documentation had to explain both: how to deploy the new features and how to operate in a mixed installation, without confusing readers familiar with the earlier product.

Several audiences

The user manual is read by the people who operate and manage the system; the service manual is read by the technicians who install, maintain, and repair it. Each group needs different information at a different level of detail.

What was at stake

Unclear or incorrect documentation leads to installation errors, misconfigured radios, support calls, and delays in getting the product into service. For equipment that controls moving locomotives, it can also affect safe operation. Documentation that is late holds up the product release itself.

Documentation Objectives

The documentation effort had two goals: to describe the product correctly and completely, and to make that information usable by the people who would install, configure, and support it.

Accuracy objectives

- **Technically correct:** every procedure, parameter, and specification checked against the product and confirmed with engineering
- **Complete coverage:** every radio in the system, its interfaces, and its configuration options documented
- **Current with the product:** documentation kept in step with design changes up to release

Usability objectives

- **Written for the reader:** content organized around the tasks each audience performs, such as installing, configuring, and troubleshooting
- **Clear on compatibility:** a clear explanation of how the new generation works with radios already in the field
- **Consistent:** the same terminology, structure, and style across both manuals

Program objectives

Objective	Measure	Target
Start	Time to begin productive work	Immediately on award
Deliverables	Manuals completed	User manual and service manual
Schedule	Manuals finished	Within the 3-month engagement
Acceptance	Client approval	Both manuals approved
Effort	Hours per week	20

Program objectives and targets.

Approach and Methodology

First Consulting's approach was to put an engineer in the technical writer role. Someone who has designed and built similar products can read specifications and source material directly, understand the product by using it, and ask engineers specific questions instead of general ones. The result is documentation that needs less correction and less of the engineering team's time.

The right person for the role

Background	Why it mattered
30+ years of embedded and real-time software development	Could understand the product's design and behavior directly from specifications and the product itself
More than ten years developing software for networked tactical radios	Already familiar with radio networking, shared channels, and multi-platform radio products
Degree in mechanical engineering and a background in motion control	Understood the machinery side of the application, not just the communications
Author of installation and operation manuals, specifications, and online help	Experienced in turning engineering knowledge into documents customers can use
National award for co-authoring a technical manual	Recognized quality as a technical author
Experience training engineers and documenting projects for handoff	Practiced at explaining complex systems to people new to them

Background of the First Consulting technical writer.

Team structure

Role	Count	Focus
Technical Writer (First Consulting)	1	Research, writing, revision, and document management
First Consulting management	—	Oversight, scheduling, and client communication
Client engineering and product team	—	Subject matter expertise, review, and approval

Team composition.

A phased methodology

Phase	Timing	Key activities
1. Onboarding	Start	Review whatever material existed and the product itself; agree on the scope of the two manuals; identify which engineers held which knowledge
2. Planning	Early	Outline both manuals, set terminology and style, and schedule interviews and reviews with engineering
3. Interviews and drafting	Bulk of engagement	Interview engineers topic by topic; draft each section from the interviews and hands-on use of the product
4. Review and revision	Ongoing	Engineering reviews; follow-up questions; incorporate comments
5. Approval	By end of month 3	Final edits and client approval of both manuals

Program phases.

Proactive engineer interviews

Because most of the product knowledge was undocumented, interviews became the backbone of the work. The writer did not wait for information to be offered. She mapped which engineers knew which parts of the system, scheduled interviews with them, came prepared with specific questions, and followed up on gaps as soon as she found them while drafting.

Her engineering background made the interviews efficient. She could follow technical explanations without asking for basics, recognize when an answer was incomplete, and turn what she heard directly into draft procedures for the engineers to check.

Writing for each audience

The user manual was organized around how people operate and manage the system; the service manual around how technicians install, configure, maintain, and troubleshoot the radios.

Governance and communication

First Consulting management oversaw the engagement and stayed in contact with the client on schedule and priorities.

Execution

Engagement at a glance

Measure	Status
Start	August 2023
Contract type	Time and materials
Effort	20 hours per week, on site as needed
Duration	3 months, as planned
Documents delivered	User manual and service manual
Outcome	Completed on time and approved by the client

Engagement summary.

Getting started

Because the writer already understood radio networking and embedded products, she could start interviewing engineers and drafting rather than spending the first part of the engagement learning the technology.

Challenges and how they were handled

Issue encountered	How the team responded	Result
Most product knowledge was undocumented and held by individual engineers	Ran a proactive, scheduled program of engineer interviews and followed up on gaps immediately	Both manuals completed on time and approved
Engineers were focused on the product release	Prepared specific questions in advance so interviews were short and productive	Interviews kept short; engineering time protected

Notable issues during execution.

Results

Deliverables

Document	Audience	Status
User manual	People who operate and manage the system	Delivered and approved
Service manual	Technicians who install, maintain, and repair the radios	Delivered and approved

Documents delivered.

Results against objectives

Metric	Target	Actual	Status
Manuals delivered	2	2	Met
Schedule	Within 3 months	Within 3 months	Met
Client approval	Both manuals	Both approved	Met

Results against program objectives.

Impact

The client received complete user and service manuals for the new product generation on schedule, approved and ready for customers. Just as important, knowledge that had existed only with individual engineers is now written down, where customers, service staff, and future engineers can use it.

Lessons Learned

The key lesson: the knowledge is in the engineers' heads

On engineering products, most of what a manual needs to say is often not written down anywhere. It lives with the engineers who built the product. A technical writer cannot wait for that information to arrive or expect to find it in specifications. It has to be collected through extensive interviews, pursued in a deliberate and proactive way from the first week of the engagement.

What worked

- **Proactive interviewing:** scheduling interviews, preparing specific questions, and chasing gaps right away kept the manuals moving despite the lack of written source material
- **An engineer in the writer role:** technical fluency made interviews faster and the drafts more accurate, which saved the engineering team's time

What is reusable

The interview-driven approach applies to any documentation effort where the product knowledge has not been written down: identify who knows what, interview early and often, and turn each interview straight into draft content for review.

Why It Matters

Engineering companies often treat documentation as the last step before release, and often staff it with writers who must learn the technology from scratch. For complex embedded products, that puts the burden back on the engineers. This engagement shows a different approach: a writer who is also an experienced engineer, who can understand the product directly and deliver documentation that needs little correction.

What this demonstrates

- **Engineer-led technical writing:** documentation written by someone who understands embedded, real-time, and radio products from the inside
- **Capturing undocumented knowledge:** a proactive interview process that turns what engineers know into finished manuals
- **On-time delivery:** user and service manuals completed within the planned three months and approved by the client
- **Fast start:** a candidate available immediately and productive with little ramp-up
- **Flexible engagement:** part-time, time-and-materials support that can be extended or scaled to the client's schedule
- **Safety-critical context:** documentation for equipment that railroads use to control locomotives
- **Management included:** First Consulting oversight at no charge to the client