

Crawford Automation – A Guided Application
of Structured Problem Solving (Thomson,
Hollis, and Turnbull)

This text is disseminated via the Open Education Resource (OER) LibreTexts Project (<https://LibreTexts.org>) and like the hundreds of other texts available within this powerful platform, it is freely available for reading, printing and "consuming." Most, but not all, pages in the library have licenses that may allow individuals to make changes, save, and print this book. Carefully consult the applicable license(s) before pursuing such effects.

Instructors can adopt existing LibreTexts texts or Remix them to quickly build course-specific resources to meet the needs of their students. Unlike traditional textbooks, LibreTexts' web based origins allow powerful integration of advanced features and new technologies to support learning.



The LibreTexts mission is to unite students, faculty and scholars in a cooperative effort to develop an easy-to-use online platform for the construction, customization, and dissemination of OER content to reduce the burdens of unreasonable textbook costs to our students and society. The LibreTexts project is a multi-institutional collaborative venture to develop the next generation of open-access texts to improve postsecondary education at all levels of higher learning by developing an Open Access Resource environment. The project currently consists of 14 independently operating and interconnected libraries that are constantly being optimized by students, faculty, and outside experts to supplant conventional paper-based books. These free textbook alternatives are organized within a central environment that is both vertically (from advance to basic level) and horizontally (across different fields) integrated.

The LibreTexts libraries are Powered by [NICE CXOne](#) and are supported by the Department of Education Open Textbook Pilot Project, the UC Davis Office of the Provost, the UC Davis Library, the California State University Affordable Learning Solutions Program, and Merlot. This material is based upon work supported by the National Science Foundation under Grant No. 1246120, 1525057, and 1413739.

Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation nor the US Department of Education.

Have questions or comments? For information about adoptions or adaptations contact info@LibreTexts.org. More information on our activities can be found via Facebook (<https://facebook.com/Libretexts>), Twitter (<https://twitter.com/libretexts>), or our blog (<http://Blog.Libretexts.org>).

This text was compiled on 12/04/2024

TABLE OF CONTENTS

[Licensing](#)

[Introduction](#)

[Acknowledgements](#)

1: Crawford Case

- [1.1: Crawford Case](#)
- [1.2: Theory- Practical Problem-Solving Approach](#)
- [1.3: Activity- Apply the Practical Problem-Solving Approach to the Case](#)
- [1.4: Alternative Text for Complex Images and Figures](#)
- [1.5: Appendices](#)

[Index](#)

[Glossary](#)

[Detailed Licensing](#)

[Detailed Licensing](#)

Licensing

A detailed breakdown of this resource's licensing can be found in [Back Matter/Detailed Licensing](#).

Introduction

1

In this case study you will apply structured problem-solving to address a common supply chain issue! What first appears as the issue may just be a symptom of a root cause. In this case study, you will be presented with a real-life problem that requires a structured approach to be solved effectively. This case is a collaboration between the Conestoga Centre for Supply Chain Innovation and ATS Automation and utilizes the ATS Business Model (ABM) approach to identifying and solving root causes.

Structured problem-solving is a process that enables individuals and teams to identify, analyze, and solve problems systematically. This approach involves breaking down complex problems into smaller, more manageable parts, and then using data and analytical tools to identify the root cause of the problem. Once the root cause has been identified, a range of possible solutions can be generated and evaluated before selecting the best one to implement.

The structured problem-solving approach has been widely used in various industries and fields, such as manufacturing, healthcare, finance, and education. It is a valuable tool for anyone who needs to solve problems efficiently and effectively, regardless of their level of expertise or experience.

In this case study, you will have the opportunity to practice your structured problem-solving skills by working through a real-life problem that requires a systematic approach to be solved. You will be presented with a detailed scenario, and you will need to apply the steps of structured problem-solving to analyze the situation, identify the root cause of the problem, and develop and evaluate potential solutions.

By the end of this case study, you will have gained a better understanding of how structured problem-solving can be applied to real-life situations, and you will have developed practical skills that you can apply to future problems you may encounter. Let's get started!

Accessibility Statement

Please review [Conestoga College's Accessibility Statement for OER Projects](#).

Authors

Stephen Thomson

Stephen is the acting director of the Centre for Supply Chain Innovation (CSCI) (formerly known as the Magna Centre for Supply Chain Excellence) at Institute of Technology and Advanced Learning in Kitchener, Ontario, Canada. Prior to becoming the director of CSCI, Stephen was a 15-year veteran of the supply chain cluster of programs. Stephen has designed and taught courses at the diploma, degree, and post-graduate level, specializing in data analytics, data visualization, and decision support modeling. Stephen is also the college's SAP faculty lead assisting programs with integrating the topics of ERP systems, business processes, simulation games, and advanced analytics into curriculum.

Over the past three years, Stephen has been a primary investigator in applied research, participating in multi-disciplinary teams focusing on projects related to supply chain analytics and sustainability. Research topics have included logistics visualizations, predictive analytics, and the development of a sustainability scorecard framework.

Stephen can be reached at sthomson@conestogac.on.ca.

Kevin Hollis

Kevin is a faculty member in the School of Business at Conestoga College ITAL. Kevin is a fulltime professor on the Supply Chain Management – Global program team, where he helps students develop skills and prepare to embark on their future work careers. Kevin is an MBA and qualified engineer with over 30 years manufacturing and supply chain management experience across multiple manufacturing sectors, warehousing & distribution, and 3PL services. Kevin also has an industrial engineering background which he has used to help organizations analyze and improve process performance.

Kevin can be reached at khollis@conestogac.on.ca.

Laurie Turnbull

Laurie Turnbull is a professor in the School of Business at Conestoga College ITAL with over twenty-five years of industry and academic experience in international business. He obtained his Masters of Science degree (MSc) in Operations and Supply Chain

Management (2016) from the University of Liverpool. Specializing in procurement, logistics, and risk management, Laurie uses that experience to help his students develop the critical skills necessary to manage global supply chains contributing to an organization's competitive advantage.

During his career in consumer goods manufacturing and the logistics service sector, Laurie frequently contributed to nationally recognized trade publications, including *Canadian Transportation & Logistics* and *Canadian Shipper*. He was awarded the CITT-Certified Logistics Professional (CCLP) designation by the Canadian Institute of Traffic and Transportation, recognizing expertise in Canadian supply chain logistics, and the Professional Materials Manager designation (P.M.M.) by the Materials Handling and Management Society. In 2014 he received the CITT Award of Excellence, given to an individual whose career has exemplified innovation in the field of supply chain logistics and who has accumulated many notable achievements.

Laurie's research interests include supply chain planning and geopolitical disruptions. He is actively involved with two of Canada's leading supply chain associations, Supply Chain Canada and CITT.

Teaching Resources

[Request the teaching resources for this case \[new tab\]](#).

Note that requesting faculty must be vetted before the teaching resources can be distributed. The teaching resources are copyrighted by the authors and all rights are reserved. Teaching resources are for teaching purposes and may not be shared or republished in any form.

Acknowledgements

2

We would like to express our gratitude to our industry collaborator, Caleb Connor, from [ATS Automation](#), for his invaluable contribution to our project! Caleb's expertise and support have been instrumental in making our vision a reality.

We would also like to extend our thanks to Kim Carter, Holly Ashbourne, Rachel Stuckey, and the Open Educational Resource team at Conestoga College ITAL, for guiding us along this journey and to Will Snyder from Media Services at Conestoga College ITAL, for making the video magic.

The authors are grateful for the partnership, collaboration, and support that has allowed us to achieve our goals.

With much gratitude,

Stephen Thomson – Director of Supply Chain Innovation

Land Acknowledgement

We wish to acknowledge and express gratitude to Indigenous peoples for their contributions as we work towards reconciliation by learning about the people, the land, and the traditional territories on which we work and reside. Conestoga College is located on the traditional territory of the Anishinaabe, Haudenosaunee, and Neutral peoples.

CHAPTER OVERVIEW

1: Crawford Case

- 1.1: Crawford Case
- 1.2: Theory- Practical Problem-Solving Approach
- 1.3: Activity- Apply the Practical Problem-Solving Approach to the Case
- 1.4: Alternative Text for Complex Images and Figures
- 1.5: Appendices

This page titled [1: Crawford Case](#) is shared under a [not declared](#) license and was authored, remixed, and/or curated by [Stephen Thomson](#), [Kevin Hollis](#), and [Laurie Turnbull](#).

1.1: Crawford Case

Problem-Solving Case Study Intro Video (2 min 22 s)

Play the video below to listen to an introduction from the coach.

One or more interactive elements has been excluded from this version of the text. You can view them online here: <https://ecampusontario.pressbooks.pub/crawfordcase/?p=51#oembed-1>

Conestoga OLC. (2023, January 25). *Problem solving case study intro* [Online video]. YouTube. Licensed for reuse [CC BY-NC-SA](#).

The New Supply Chain Manager

It was early Monday morning, October 2, 2022, and Priyanka Kaur was starting her second week as the new Supply Chain Manager at Crawford Automation in Barrie, Ontario, Canada. She was thrilled when the company offered her the job and still couldn't believe her good fortune. Before leaving India to pursue an opportunity as an international student in Canada, with a chance to find a full-time job, she had already completed a degree in Mechanical Engineering. In addition, she had several years of experience in the fabrication industry in her hometown of Kolkata, India, including supervisory experience, so she was ready for the role of Supply Chain Manager with Crawford Automation. Still, she couldn't help but notice the culture at Crawford was almost exclusively male-dominated, which explained her response when HR called to offer her the job, "Really? Oh my, I can't believe it! Yes, yes, I accept the position. Thank you, I am very grateful."

However, those concerns faded into the background as Kaur immersed herself in the onboarding process at Crawford. The first week had been reserved for "new hire" orientation comprising the usual Human Resources onboarding processes, touring the office area, meeting administrative employees, and training on the company's ERP system (see [Appendix A for the organizational chart](#)). She also had an opportunity to spend time with the company's General Manager, Hugh Robertson, who explained the company's history, competitive marketing position, and strategic plans for the coming year.

Her overall responsibilities included purchasing, logistics, and inventory management, and towards the end of the week, she finally got a chance to meet her staff. Kaur has a small team of two-to-three employees in each area, but it was clear they had their hands full and were pleased the company had hired a new Supply Chain Manager.

Purchasing at Crawford Automation

Kaur had previous experience in logistics and inventory control and was comfortable with those responsibilities. However, she had little direct experience in purchasing and was unsure in that role. This became more evident when her Purchasing Supervisor, Kevin MacDonald, described the scope of their department's operations, including the number of domestic and international suppliers involved, the sophistication of the parts they ordered, and the logistics requirements related to ensuring supplier deliveries were on time for production. Kaur realized the importance of that relationship when MacDonald mentioned that supplier on-time delivery had been declining in recent months: it was currently 75% but the company requirement is 95% on-time delivery.

Kaur was determined to get down to business, and her first meeting was with Harvey Morrison, the Plant Manager. Morrison had been with the company for over ten years and proved to be a wealth of knowledge about everything and everyone.

Morrison took Kaur on a tour of the Plant, explaining the various production processes underway. "Do you have any experience in the automation business, Priyanka?" Morrison asked as they made their way between several workstations. "A little," Kaur replied. "I worked in a metal fabrication company for several years before coming to Canada. We specialized in the airline industry, fabricating wing and fuselage parts from high-density composite materials for some of the largest airlines in the world."

"Sounds interesting," said Morrison. "We may not be a 'highflyer' like your previous employer, but we're pretty advanced in our own way. Our customers are manufacturing companies, mostly consumer goods producers but some industrial clients as well. When they need a new machine or automated conveyor system, they come to us and ask us to produce it, and sometimes design it too. It could be a new machine to produce a brand-new product, or a bigger machine to produce more volume of an existing product."

Kaur stopped and pushed several large boxes aside to get a better look around. "So, all the people in this area are working on the same thing?" she asked Morrison.

“Could be,” he answered. “But, keep in mind, we’re talking about highly sophisticated machinery. For example, right now we’re producing a high-volume extrusion molding machine for a large consumer beverage company. It’s only one machine, but it will produce thousands of bottles per minute that will feed into their conveyor systems and be filled with beverage products. A machine like this has to be built from scratch, hundreds of different parts, most we design and make ourselves, but some come from our suppliers.”

“I’m glad I asked,” Kaur replied. “That gives me a better idea of the role my departments play in all of this.” Morrison steered Kaur back towards the office area, saying, “Well, now that you mention it, there’s something I wanted to talk to you about your department and some problems we’ve been having.”

“Oh, are you saying my employees aren’t doing their jobs very well?” Kaur asked.

“Look, Priyanka, don’t take this the wrong way,” Morrison said. “You saw how many people I have working out there. Our customers pay up to one million dollars for some of these machines, sometimes more, therefore they demand high-quality and on-time delivery. I’m glad the company hired you, it’s no secret that we have had some significant production delays this year because the supply chain department couldn’t arrange the delivery of parts and materials to meet my production schedules.”

Kaur considered this for a moment and said, “Harvey, thank you for the tour and the insights into some of the problems in my department. I assure you this will be a top priority for me and I will look into it immediately.”

“Thank Goodness You’re Finally Here.....!”

Kaur knew firsthand the importance of timely supplier deliveries from her experience in the fabrication industry. Back in her department, she decided to talk to MacDonald: “Harvey Morrison just gave me a Plant tour, and from his comments, I get the impression he’s not too happy with some of your suppliers.”

“Look, Priyanka,” said Kevin defensively, “these suppliers were in place long before I got here, so they must know what they’re doing. When things don’t show up, I get phone calls from Mike Brown demanding to know where his order is. Call the suppliers, and it’s the same story every time. They tell me our orders were shipped on schedule and that I should call the trucking companies or check with Receiving. I call the carriers, and they say they don’t have it. Then I call Paul Robertson and he says he hasn’t seen it either. But between you and me, I’m not sure he would know, so thank goodness you’re finally here to help sort things out!”

“What do you mean by that?” Kaur asked.

“My team has been tracking missed on-time deliveries (OTD) for the last two months (see [Appendix B for Late PO data](#)) and we have found the main issue is incorrect data entry; however, I am unclear on how to present this data and what the next steps to improve the situation are. I know that receiving is one of the busiest areas in the company and floor space is in short supply, so maybe they are having difficulty locating the orders.”

Kaur was able to take a quick look at the Late Purchase order data the purchasing team has compiled and recommended that a Pareto diagram would be the most effective method to show the data and explained that she was going to introduce a tool called an Ishikawa diagram (commonly referred to as a “Fishbone”) to the team soon. Kaur was interested to see if anything in the data provided indicated their suppliers were performing unsatisfactorily.

The Receiving Department

Kaur asked MacDonald to generate a supplier performance report for the company’s key suppliers, then headed back to the Plant to speak with Paul Robertson, the Shipping & Receiving Supervisor. The Shipping & Receiving department was not included in her tour with Morrison, and she was curious after hearing MacDonald’s comments.

When she arrived at the Shipping & Receiving department, she saw that MacDonald might have a point. Boxes and crates of all shapes and sizes filled the area to the point where it was difficult to find an aisle and in one of the receiving docks was a skid full of random boxes blocking access for any material handling equipment (MHE). She asked one of the staff on the floor and was told: “I think that stuff came in yesterday and it is all the receipts with discrepancies, so we are waiting for purchasing to tell us what to do with them. When a shipment arrives we have to match the purchase order, with the packing slip, and the label on the boxes. None of these boxes match.”

Finally, behind a solid wall of boxes, Kaur discovered the Shipping Office and, inside, was Paul Robertson.

An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://ecampusontario.pressbooks.pub/crawfordcase/?p=51#h5p-1>

Looking at the purchase order Robertson just showed her, Kaur realized this is exactly the same missing roller bearing MacDonald could not find (see [Appendix C – Purchase Order](#)).

The Problem

Later that day, around 4 p.m. Kaur received an email from Morrison asking if she could come to the production area. When she arrived, Morrison waved her over to one of the workstations.

“Thanks for coming. I thought it would help if you saw this for yourself. We’re supposed to install the ball bearings on this machine today, but now we have found out we don’t have any. The inventory records say we should have two in stock, but we don’t. Kevin tells me the supplier says they shipped our order three days ago, which contained 15 sets of Part #: 9902233567 Roller Bearings required for this job. Orillia to Barrie is usually next-day delivery with the trucking company, but Robertson says he never received the order.” (see [Appendix C – Purchase Order](#))

Kaur saw that Morrison was waiting for an answer from her and asked, “What do you suggest I do?”

“I don’t know; I just thought you should see firsthand the problems we’re having with some of your suppliers,” Morrison replied as he handed Kaur a copy of the inventory record. “I could ask Paul to drive up to Orillia and pick up the part, but he won’t get there before 4:30, and since this has happened before, Orillia Components will charge us an overtime pickup penalty of \$500 for a \$60 part. And since there will be rush hour traffic on Highway 400 at this time of day, he’ll be lucky to get back here by 8 p.m. tonight, and I can’t keep my Production department on overtime waiting for him.

Kaur thought for a moment about the supplier analysis she had just completed. “Harvey, it’s too late to do anything about this today. Leave it with me, and I’ll get back to you first thing tomorrow morning.”

The After-Hours Investigation

Before she left for home, Kaur needed to make a plan. How will she and the team determine what had happened to the missing part and figure out what the **root cause** of this recurring issue is? She knew she needed to see the issues firsthand and collect data to understand the extent of the issue and to set a baseline of performance.

One of the first things Kaur requested was a supplier performance report and the supplier performance scorecards for the top five vendors. She was informed that the accounting department creates and publishes scorecards and that the performance reports were not up to date. Furthermore, it would take accounting weeks to gather, organize, and summarize the data. She decided to ask her purchasing team to perform the analysis. Crawford’s IT department has set up an analytics self-serve where managers have direct access to download data directly from SAP (the company’s enterprise resource planning system) directly into Excel to perform analysis and data visualizations ([Download the SAP data file \[downloads an Excel file\]](#)).

Utilizing the self-serve tool, Kaur was able to download the complete Key Supplier Performance report (see [Appendix D – Key Supplier Performance Report](#)). One of the key findings she is hoping to see is whether the Crawford purchasing team is providing their vendors with the required five day lead time (time between the date *ordered* and date *required*) and whether supplier confirmation dates are consistently entered.

Kaur wanted to do one more thing before she went home and waited in her office until 7 p.m., long after the plant had closed and everyone had left for the day. Armed with a flashlight, a copy of the Purchase Order to Orillia Components (see [Appendix C – Purchase Order](#)), and the packing slip from the receipt (see [Appendix E – Packing Slip](#)) she went to see if she could find the missing roller bearings.

Can you find the box containing the missing parts in this pile? When the box is located can you identify the discrepancy between the Purchase Order, Packing Slip, and the box label?

One or more interactive elements has been excluded from this version of the text. You can view them online here: <https://ecampusontario.pressbooks.pub/crawfordcase/?p=51>

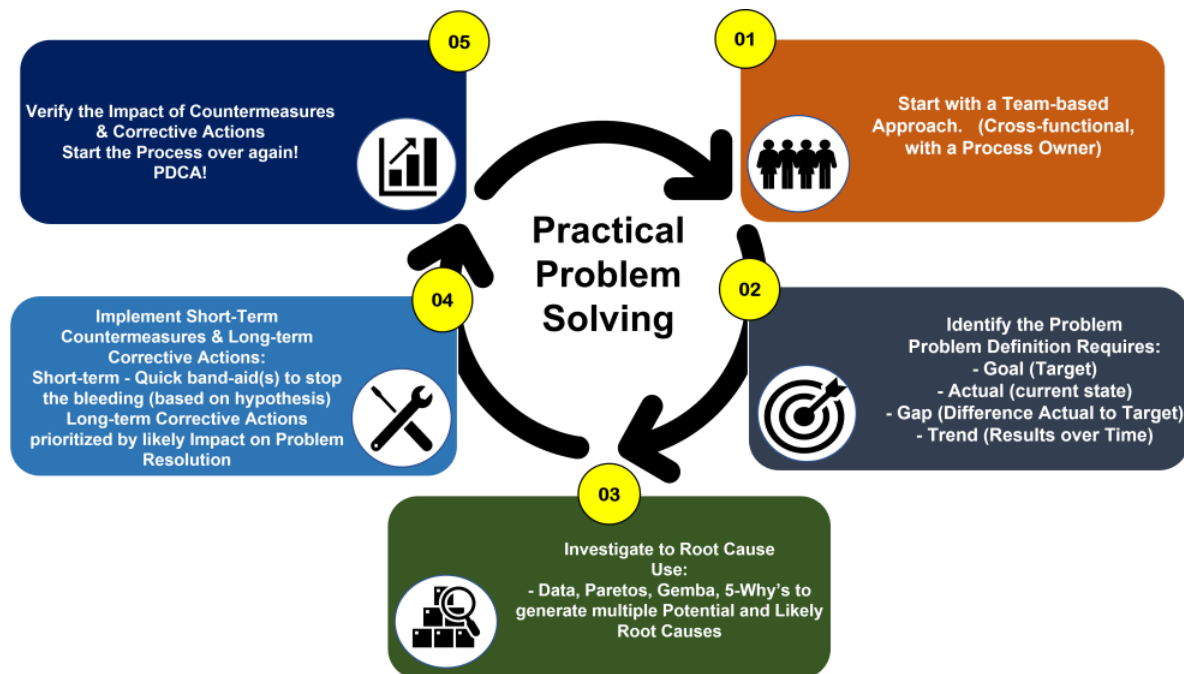
As she walks towards the receiving area, Kaur is thinking, “The only way to solve this problem is to use the structured problem-solving approach I was taught in school and has worked in the past. It is important that I find the root cause to this issues, or else they will keep happening.”

As part of Kaur's team, you will use a structured problem-solving approach to find the root cause of Crawford's supply chain problems and help the team determine countermeasures that will improve this situation once and for all.

This page titled [1.1: Crawford Case](#) is shared under a [CC BY-NC-SA 4.0](#) license and was authored, remixed, and/or curated by [Stephen Thomson](#), [Kevin Hollis](#), and [Laurie Turnbull](#).

1.2: Theory- Practical Problem-Solving Approach

5-Step Practical Problem-Solving Process



This is an adaptation of the 5-Step Practical Problem-Solving Process used at ATS Automation (based in Cambridge, Canada), as part of their ATS Business Model (ABM). [\[Image description\]](#)

This page titled [1.2: Theory- Practical Problem-Solving Approach](#) is shared under a [CC BY-NC-SA 4.0](#) license and was authored, remixed, and/or curated by [Stephen Thomson, Kevin Hollis, and Laurie Turnbull](#).

1.3: Activity- Apply the Practical Problem-Solving Approach to the Case

Activity: Application of Structured Problem Solving

Watch the following videos of Caleb Connor (ABM Lead) from ATS Automation introducing the concept of structured problem-solving.

One or more interactive elements has been excluded from this version of the text. You can view them online here: <https://ecampusontario.pressbooks.pub/crawfordcase/?p=55#oembed-1>

Conestoga OLC. (2023, January 25). *Problem-solving case study step 1* [Online video]. YouTube. Licensed for reuse [CC BY-NC-SA](#).

Step 1: Define the Team!

Who would be best involved in this Problem-Solving Team? List the roles you would want to involve.

1. Use the organizational chart to choose who should be involved in the project and explain their role and why they should be on the team. (see [Appendix A – Organizational Chart](#))

One or more interactive elements has been excluded from this version of the text. You can view them online here: <https://ecampusontario.pressbooks.pub/crawfordcase/?p=55#oembed-2>

Conestoga OLC. (2023, January 25). *Problem-solving case study step 2* [Online video]. YouTube. Licensed for reuse [CC BY-NC-SA](#).

Step 2: Identify the Problem

1. What are the targets of on-time supplier delivery? Given the table below, graph the data and determine the performance over the past 12 months, **by month and in total**. Is there a trend or pattern (# of PO On-time / # of PO)? What is the identified gap?

Month	# of PO Receipts	# of Late PO Receipts	# of Supplier Scorecards Issued
January	1256	378	0
February	1344	399	0
March	1452	433	0
April	1678	433	2
May	1198	278	3
June	1098	245	4
July	987	203	6
August	970	199	8
September	1409	245	11
October	1987	280	13
November	2240	300	15

Month	# of PO Receipts	# of Late PO Receipts	# of Supplier Scorecards Issued
December	2334	298	16

2. From this analysis, construct a single-sentence problem statement.

One or more interactive elements has been excluded from this version of the text. You can view them online here: <https://ecampusontario.pressbooks.pub/crawfordcase/?p=55#oembed-3>

Conestoga OLC. (2023, January 25). *Problem-solving case study step 3* [Online video]. YouTube. Licensed for reuse CC BY-NC-SA.

Step 3: Investigate the Root Cause.

- Review and analyze the data collected on late purchase orders. (see [Appendix B for Late PO data](#)) – The team also conducted a follow-up study of a selection of problem purchase orders over the past two months to help identify the root cause, or causes, of these missing and late purchase orders.
 - How does this data start to inform your understanding of the issue?
- Review the Ishikawa / Fishbone Diagram – The team did this as pre-work to inform this analysis. (see [Appendix F – Ishikawa Diagram – Top Three Analysis](#)) Multiple possible problem areas were identified under six broad categories, and following a team vote, the most popular were identified and highlighted in blue together with the number of votes each received. The three that received the highest votes are shown in Appendix F – Top Three Analysis together with an assortment of possible root causes for each. Review the 14 possible root causes shown in the Top Three Analysis against the information provided in the case study.
 - Which three possible root causes would you choose to investigate further?
- What data provided in the case study have you used to support your selections for further investigation? Complete the supplier performance table shown in Appendix D (see [Appendix D – Key Supplier Performance Report](#)) to complete the report you must utilize the data from the provided workbook. ([Download the Excel File with Crawford Case Data](#))
 - What observations can you make from the completed supplier performance report data?
 - Are there any relationships or connections between the supplier performance data that support or contradict the possible root causes listed in:
 - Appendix F – Ishikawa Diagram,
 - Appendix B – Late PO data?
 - Reconsider the question asked above — “Which three possible root causes would you choose to investigate further?” — and based on the additional supplier performance data, identify if your selections have changed from those you identified earlier? If so, why?
- Go to the Gemba. Kaur has decided that your team needs to look for the missing part 998223356, which the vendor said was shipped to Crawford Automation. You will need to review the PO and the Packing Slip for this part, which can be found in Appendix C (see [Appendix C – Purchase Order](#)), and Appendix E (see [Appendix E – Packing Slip](#)).
 - Did you find the box?
 - Why do you think the box had not been received?

One or more interactive elements has been excluded from this version of the text. You can view them online here: <https://ecampusontario.pressbooks.pub/crawfordcase/?p=55>

Step 3: Investigate the Root Cause Continued

- Conduct a Five Whys analysis and complete the table in Appendix G (see [Appendix G – The Five Whys Template](#)).

There are four main steps to using the Five Whys template:

- The observed problem is documented to initiate the process.
- Use the template to document the answers to the following questions.

- a. Why (#1) is the observed problem happening?
- b. What Gemba evidence supports the answers generated?
3. Continue the process for Why (#2) through to Why (#5) as required.
 - a. Why (#2) are the answers/findings in the previous step happening?
 - b. What Gemba evidence supports the answers generated?
4. Repeat the process by asking up to five Why questions until the root cause(s) are identified.

One or more interactive elements has been excluded from this version of the text. You can view them online here: <https://ecampusontario.pressbooks.pub/crawfordcase/?p=55#oembed-4>

Conestoga OLC. (2023, January 25). *Problem-solving case study step 4* [Online video]. YouTube. Licensed for reuse CC BY-NC-SA.

Step 4: Identify and Implement Countermeasures

Using the Five Whys analysis, identify for each root cause a short-term countermeasure to ensure the issue does not get worse and a long-term countermeasure to fix forever (process improvement).

1. Does every action have a clear action, owner, and due date?

One or more interactive elements has been excluded from this version of the text. You can view them online here: <https://ecampusontario.pressbooks.pub/crawfordcase/?p=55#oembed-5>

Conestoga OLC. (2023, January 25). *Problem-solving case study step 5* [Online video]. YouTube. Licensed for reuse CC BY-NC-SA.

Step 5: Verify the Impact of Countermeasures and Start Again

It is important in this step that your next review meeting is scheduled and that the team begins to collect the data to measure the impact of countermeasures.

1. Choose one of the recommended corrective actions and identify which of Crawford's performance measures (as discussed in the case) should be impacted.
2. For the chosen action, identify a performance measure that could be negatively impacted by the corrective action. For example, quality may suffer when operators are asked to increase speed.

This page titled [1.3: Activity- Apply the Practical Problem-Solving Approach to the Case](#) is shared under a [CC BY-NC-SA 4.0](#) license and was authored, remixed, and/or curated by [Stephen Thomson, Kevin Hollis, and Laurie Turnbull](#).

1.4: Alternative Text for Complex Images and Figures

5-Step Practical Problem-Solving Process

The Practical Problem-Solving Cycle involves five steps:

1. Start with a team-based approach. This should be cross-functional with a process owner.
2. Identify the problem. Problem identification requires a goal (target), an actual baseline (the current state), a gap (the difference between the actual and target), and a trend (results over time).
3. Investigate the root cause. Use data, the Pareto principle, Gemba, and the Five Whys methods to generate multiple potential root causes and likely root causes.
4. Implement short-term countermeasures and long-term corrective actions. Short-term countermeasures are quick “Band-Aids to stop the bleeding” and are based on hypotheses. Long-term corrective actions are prioritized by their likely impact on the problem’s resolution.
5. Verify the impact of countermeasures and corrective actions and then start the cycle again.

[\[Back to image\]](#)

Appendix A – Organization Chart

This organizational chart depicts the reporting structure of Crawford Automation. There are three levels from top to bottom.

1. Hugh Robertson, general manager.
2. Direct reports to Hugh Robertson: Frank Jamieson (Marketing and Sales Manager), Harvey Morrison (Plant Manager), Priyanka Kaur (Supply Chain Manager), and Tanya Smith (Human Resources Manager).
3. Direct reports to second-level managers. Jack Tennyson (Ontario Sales), Gilles Langlois (Eastern Canada Sales), and Kyle Adams (Western Canada Sales), report to Frank Jamieson (Marketing and Sales Manager). Michael Brown (Production Supervisor), Arthur Shepherd (Material Coordinator), Neil Sinclair (Maintenance Supervisor), and Paul Robertson (Shipping and Receiving Supervisor) report to Harvey Morrison (Plant Manager). Kevin MacDonald (Purchasing Supervisor), Brian Stewart (Logistics Supervisor), and Linda Jamieson (Inventory Supervisor) report to Priyanka Kaur (Supply Chain Manager). Rosemary Clark (Human Resources Supervisor), Jim Baker (Human Resources Clerk), and Maria Lopez (Benefits Administrator) report to Tanya Smith (Human Resources Manager). End of the organizational chart.

[\[Back to figure\]](#)

Appendix F – Ishikawa Diagram

This Ishikawa diagram shows six broad areas of consideration and the potential root causes within each area. The team cast votes to determine the most likely root causes, which are highlighted in blue, together with the number of votes each potential root cause received. The six broad areas and associated possible root causes identified in the diagram are:

1. Mother Nature (Environment) – comprising possible root causes: Winter weather, Customs delays, Cargo bumping, and Supplier execution (highlighted blue with 10 votes received)
2. People (Resource) – comprising possible root causes: Data management – confirmation not entered (highlighted in blue with 7 votes received), Data entry error by Receiver, Data entry error by Buyer, Process adherence, and Received out of sequence by Receiver (highlighted in blue with 1 vote)
3. Method (Process) – comprising possible root causes: Supplier selection, Supplier relationship management (highlighted in blue with 9 votes received), and Purchase order re-approval / delayed receipt
4. Material – comprising possible root causes: Incorrect freight terms on a Purchase order, Address book set-up, and Commodity performance (highlighted in blue with 1 vote received)
5. Machine – comprising possible root causes: Purchase order issue due to SAP discrepancy, and purchase order receipt out of date
6. Measurement – comprising possible root causes: How we calculate OTD – i.e. transit (highlighted in blue with 1 vote received), Supplier clarification of delivery date shipped versus date received, Movement and disposition time– QA inspection in building 2, No confirmation date received (highlighted in blue with 1 vote received), and By-pass receiving

[\[Back to figure\]](#)

Appendix F1 – Ishikawa Top Three

This figure depicts the top three most likely root cause areas identified through the completion of the Ishikawa diagram in Appendix F.

1. Supplier execution. This received 10 votes. Supplier execution includes delta between request and promise, top contributing suppliers to on-time delivery, transit offset validation, delta between promise and actual, line volumes versus on-time delivery performance, percentage of order completion, ABC complexity versus on-time delivery, manufacturing versus purchase on-time delivery, and geographical versus on-time delivery.
2. Supplier relationship management. This received 9 votes. Supplier relationship management includes the number of supplier corrective action reports issued versus on-time delivery, score cards issues versus on-time delivery, supplier longevity versus on-time delivery, and invoice issues by the supplier.
3. Data management. This received 7 votes and includes invoice issues by the buyer.

[\[Back to image\]](#)

Appendix G – The Five Whys Template

The template is a table with three double-column sections, one for each cause. Each cause is divided into two columns, one with the heading Why? and one with the heading Evidence. The table has five rows with empty cells to fill in the Whys and Evidence for each cause.

There are four main steps to using the Five Whys template:

1. The observed problem is documented to initiate the process.
2. Use the template to document the answers to the following questions.
 1. Why (#1) is the observed problem happening?
 2. What Gemba evidence supports the answers generated?
3. Continue the process for Why (#2) through to Why (#5) as required.
 1. Why (#2) are the answers/findings in the previous step happening?
 2. What Gemba evidence supports the answers generated?
4. Repeat the process by asking up to 5 Why questions until the root cause(s) are identified.

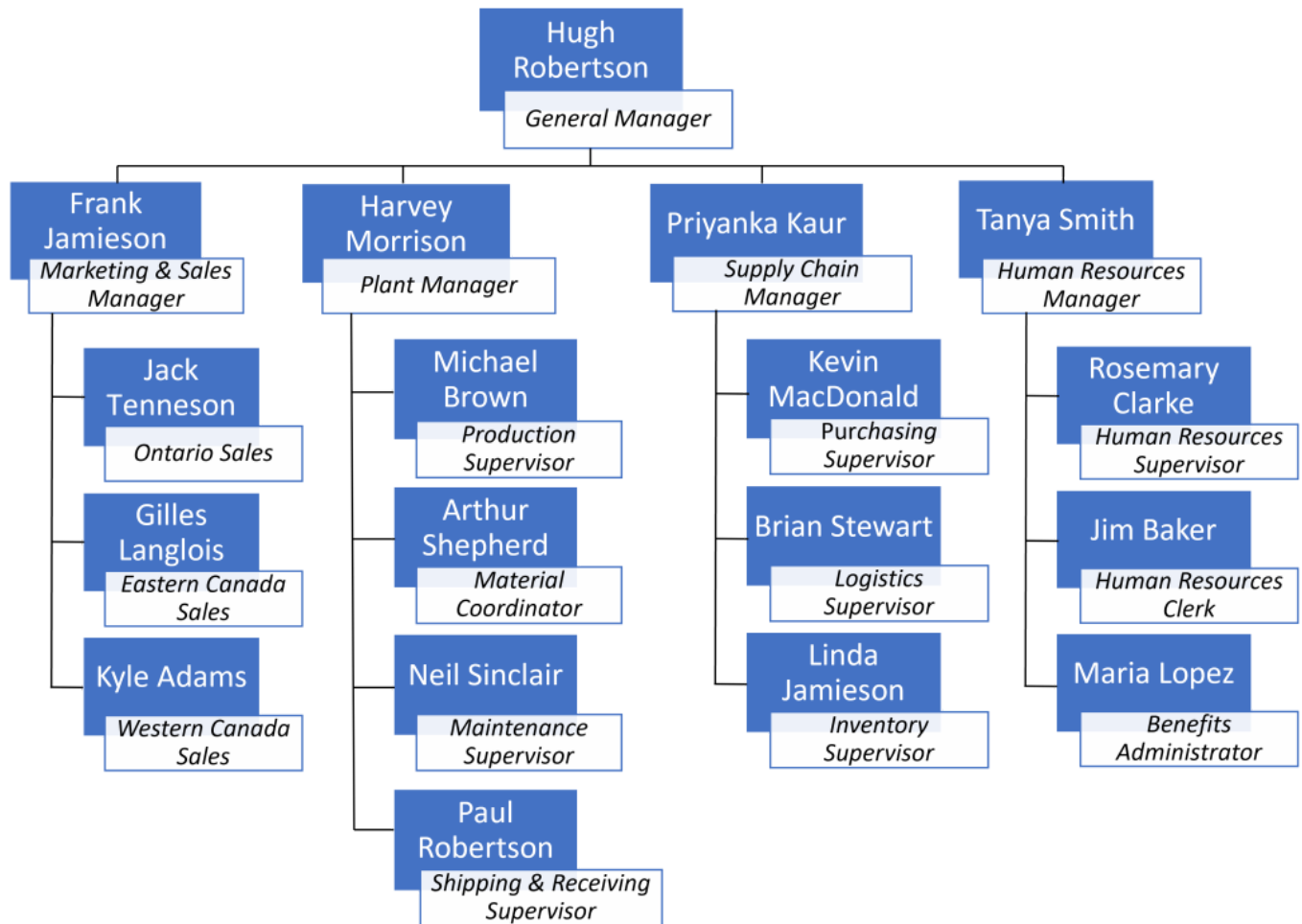
[\[Back to template\]](#)

This page titled [1.4: Alternative Text for Complex Images and Figures](#) is shared under a [CC BY-NC-SA 4.0](#) license and was authored, remixed, and/or curated by [Stephen Thomson, Kevin Hollis, and Laurie Turnbull](#).

1.5: Appendices

Appendix A – Organizational Chart

Organizational Chart



[Image description for organizational chart.]

[Return to Case Text]

[Return to Activity Step 1]

Appendix B – Late PO Data

Reasons for Late (PO Lines)	Month 1	Month 2
Incorrect Data Entry	12	13
Documentation Issue	4	3

Reasons for Late (PO Lines)	Month 1	Month 2
Expedite Request – Could not be executed	1	3
Vendor – Over Capacity	5	5
Quality Issue – Reject	4	1
Wrong Shipment Method	1	2
Incorrect Item Shipped	0	0

A follow-up study on Incorrect Data Entry was conducted to gain further insights.

Incorrect Data Entry	Month 1	Month 2
Receipt Incorrect	1	1
Receipt not Entered on Time	4	6
Incorrect or Missing Promise Date	6	5
Unknown	1	1

[\[Return to Case Text\]](#)

[\[Return to Activity Step 3\]](#)

Appendix C – Purchase Order

PO #: 6579902
DATE: 10/03/2022

ISSUED TO:
Orillia Components
408 3rd Street
Orillia, ON
L3V 4K4

SHIP TO:
Crawford Automation
155 Dunlop St. West
Brampton, ON

COMMENTS OR SPECIAL INSTRUCTIONS:
Please ensure PO# is identified on all labels, packing slips, and invoices.

SALESPERSON	QUOTE	REQUISITIONER	SHIPPED VIA	F.O.B. POINT	TERMS
	1333-3	ST	Own Truck	Origin	2% 10 Net 30 Days

QUANTITY	DESCRIPTION	UNIT PRICE	TOTAL
35 ea	7703455 Stainless Steel 1/2 Inch Flange	37.97	1,329.30
60 ea	82398 Component Roller Wheels	17.00	1,020.00
15 ea	9902210547 Roller Bearings- Engineering Code G	65.25	978.75
30 rolls	236884645 Conveyor Belt Friction Tape	14.99	449.70
1 kit	34522 Portable Install Kit	535.00	535.00

[Accessible purchase order \[downloads a Word document\].](#)

[\[Return to Case Text\]](#)

[\[Return to Activity Step 3\]](#)

Appendix D – Key Supplier Performance Report

(Jan. 1 – Dec. 31, 2022)

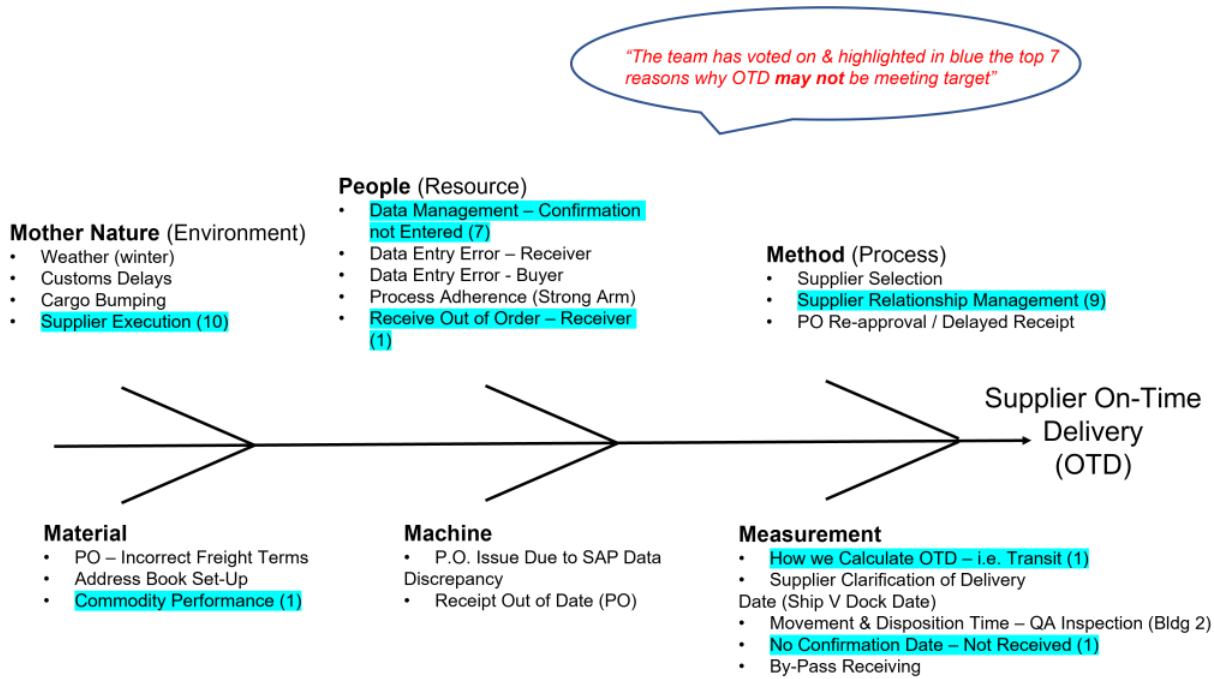
Supplier	Location	Part/Material	# of Purchase Orders (PO)	Purchase Order Value	% PO Delivered on Time	Average Order Lead Time	% of PO with Confirmation Dates	% of PO Delivered Complete *
Orillia Components LTD.	Orillia, ON, Canada	Power distribution cable harness						
TSMC	Hsinchu, Taiwan	Programmable controller						
Precision Gear Corp	Monterrey, Mexico	Hydraulic gear subassembly						
Adams Machine Co.	Edmonton AB Canada	Feeder tray						
Lakeshore Robotics	Belleville, ON, Canada	Motor control drive system						

- Notes: For the purposes of analysis you will need create formulae and use logical and summary spreadsheet functions to calculate the measures for the Key Supplier Performance Report.
- # of Purchase Orders: The # of Purchase Orders placed with each supplier.
- Purchase Order Value: The total value of Purchase Orders for each vendor
- % of PO Delivered on Time: This calculation requires logic. If there is no promise/confirmation date then a on-time order is when the Date Delivered = Promise/Confirmation Date. When the confirmation date is missing then an on-time order is when the Date Delivered = Date Required
- Average Order Lead Time – Lead Time = days difference between Date Ordered and Date Required
- % of PO with Confirmations – The % of purchase orders that had confirmation dates, summarize for each supplier
- % of PO Delivered Complete – A complete order is defined when the # of lines delivered = # of lines ordered

[\[Return to Case Text\]](#)

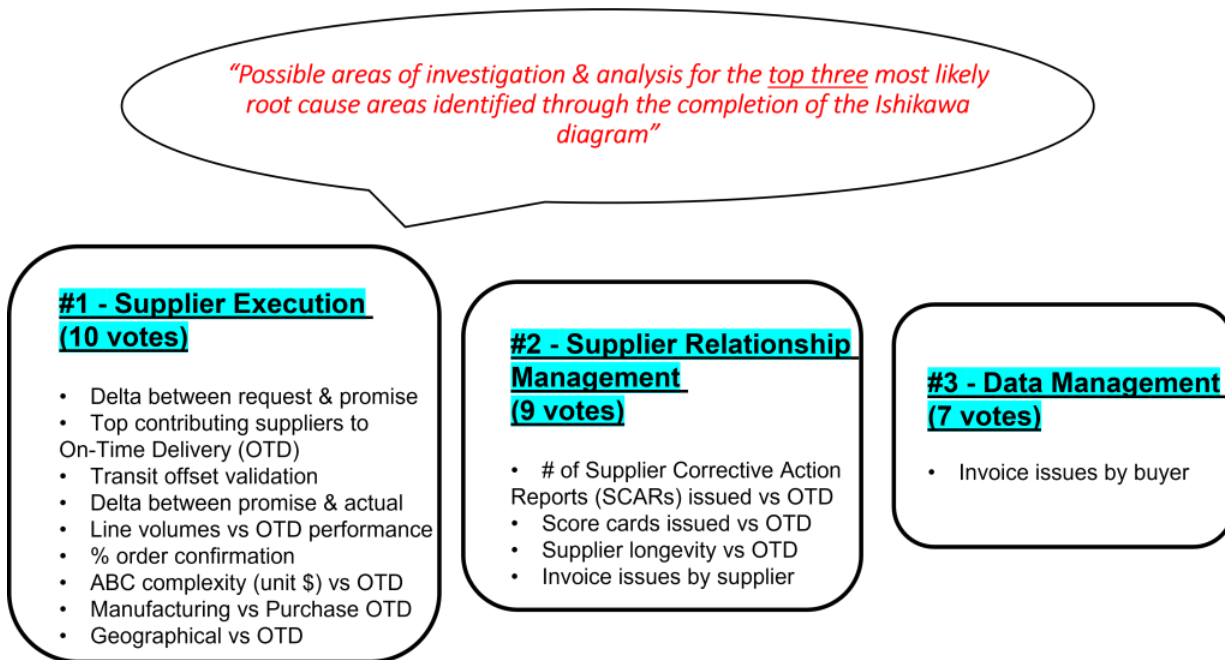
[\[Return to Activity Step 3\]](#)

Appendix E – Packing Slip



[Image description for Ishikawa Diagram]

Appendix F1 – Ishikawa Top 3 Analysis



[Image description for Ishikawa Top Three Analysis]

[\[Return to Activity Step 3\]](#)

Appendix G – The Five Whys Template

The Five Whys Template

This Five Whys template is used to systematically identify the root causes of problems observed in the workplace. It is in table form and allows users to document the observed effects of three different problems and then focus on the root cause by

documenting the Gemba evidence found in answer to the question “Why?”.

5 Whys Analysis						
	Cause #1		Cause #2		Cause #3	
	What?	How did it happen?	What?	How did it happen?	What?	How did it happen?
i						
ii						
iii						
iv						
v						

[Image description for Five Why analysis template.]

[Accessible Five Whys analysis template \[downloads a Word document\].](#)

[\[Return to Activity Step 3 Continued\]](#)

This page titled [1.5: Appendices](#) is shared under a [CC BY-NC-SA 4.0](#) license and was authored, remixed, and/or curated by [Stephen Thomson](#), [Kevin Hollis](#), and [Laurie Turnbull](#).

Index

D

dire

Detailed Licensing

Overview

Title: [Crawford Automation – A Guided Application of Structured Problem Solving](#) (Thomson, Hollis, and Turnbull)

Webpages: 19

Applicable Restrictions: Noncommercial

All licenses found:

- [Undeclared](#): 57.9% (11 pages)
- [CC BY-NC-SA 4.0](#): 42.1% (8 pages)

By Page

- [Crawford Automation – A Guided Application of Structured Problem Solving](#) (Thomson, Hollis, and Turnbull) - [CC BY-NC-SA 4.0](#)
 - [Front Matter](#) - [Undeclared](#)
 - [TitlePage](#) - [Undeclared](#)
 - [InfoPage](#) - [Undeclared](#)
 - [Table of Contents](#) - [Undeclared](#)
 - [Licensing](#) - [Undeclared](#)
 - [Introduction](#) - [CC BY-NC-SA 4.0](#)
 - [Acknowledgements](#) - [CC BY-NC-SA 4.0](#)
 - [1: Crawford Case](#) - [Undeclared](#)
 - [1.1: Crawford Case](#) - [CC BY-NC-SA 4.0](#)
 - [1.2: Theory- Practical Problem-Solving Approach](#) - [CC BY-NC-SA 4.0](#)
 - [1.3: Activity- Apply the Practical Problem-Solving Approach to the Case](#) - [CC BY-NC-SA 4.0](#)
 - [1.4: Alternative Text for Complex Images and Figures](#) - [CC BY-NC-SA 4.0](#)
 - [1.5: Appendices](#) - [CC BY-NC-SA 4.0](#)
 - [Back Matter](#) - [Undeclared](#)
 - [Index](#) - [Undeclared](#)
 - [Glossary](#) - [Undeclared](#)
 - [Detailed Licensing](#) - [Undeclared](#)
 - [Detailed Licensing](#) - [Undeclared](#)

Detailed Licensing

Overview

Title: [Crawford Automation – A Guided Application of Structured Problem Solving](#) (Thomson, Hollis, and Turnbull)

Webpages: 19

Applicable Restrictions: Noncommercial

All licenses found:

- [Undeclared](#): 57.9% (11 pages)
- [CC BY-NC-SA 4.0](#): 42.1% (8 pages)

By Page

- [Crawford Automation – A Guided Application of Structured Problem Solving](#) (Thomson, Hollis, and Turnbull) - [CC BY-NC-SA 4.0](#)
 - [Front Matter](#) - [Undeclared](#)
 - [TitlePage](#) - [Undeclared](#)
 - [InfoPage](#) - [Undeclared](#)
 - [Table of Contents](#) - [Undeclared](#)
 - [Licensing](#) - [Undeclared](#)
 - [Introduction](#) - [CC BY-NC-SA 4.0](#)
 - [Acknowledgements](#) - [CC BY-NC-SA 4.0](#)
 - [1: Crawford Case](#) - [Undeclared](#)
 - [1.1: Crawford Case](#) - [CC BY-NC-SA 4.0](#)
 - [1.2: Theory- Practical Problem-Solving Approach](#) - [CC BY-NC-SA 4.0](#)
 - [1.3: Activity- Apply the Practical Problem-Solving Approach to the Case](#) - [CC BY-NC-SA 4.0](#)
 - [1.4: Alternative Text for Complex Images and Figures](#) - [CC BY-NC-SA 4.0](#)
 - [1.5: Appendices](#) - [CC BY-NC-SA 4.0](#)
 - [Back Matter](#) - [Undeclared](#)
 - [Index](#) - [Undeclared](#)
 - [Glossary](#) - [Undeclared](#)
 - [Detailed Licensing](#) - [Undeclared](#)
 - [Detailed Licensing](#) - [Undeclared](#)