

Plan-Do-Check-Act (PDCA) Based Approach to Business Process Mapping

Arun Kumar Kathirvel

GlobalFoundries Inc.

Malta, NY 12020, US

arunkumaar.kathirvel@globalfoundries.com

Carolyn Paddock-Moore

GlobalFoundries Inc.

Burlington, VT 05452, US

carolyn-paddock.moore@globalfoundries.com

Shiladitya Chakravorty

GlobalFoundries Inc.

Malta, NY 12020, US

shiladitya.chakravorty@globalfoundries.com

Abstract

Process maps provide a significant level diagram of an organization's business processes and Business Process Maps are techniques that are used as tools to boost the organization's performance and upgrade the efficiency. This paper proposes a methodology, integrating the Deming's Plan-Do-Check-Act (PDCA) cycle and Business Process Maps scope. The utilization of the suggested method is validated through an undertaking of a research-based case study on creating New Product Introduction (NPI) process maps. The effects of the case study determine that the projected PDCA-based approach to deal with Business Process Maps will be a compelling option to show the perceivability of end-to-end processes.

Keywords

Business Process Maps, Plan-Do-Check-Act (PDCA), Operations Management.

1. Introduction

Business Process Maps are used as a tool for business improvement. It has been stated as a useful technique that conducts process improvements in business and knowledge acquisition of organization and their mankind. Process maps, being a knowledge storehouse is found to have more merit that is farther away than the development of improved business process. The crucial element for knowledge collaboration and transfer is socialization. This method gives the perception about the usage of business process maps as a technique for aiding the acquisition of knowledge in each person. In this paper, we will see an overview of business process maps, their types and benefits, etc. followed by a case study using PDCA cycle for mapping business processes.

1.1 Business Process Maps

Processes are an important part of the way each business is managed, and the more clarity one has to understand what they are, how they work, and the impact they need, the greater one's ability to get into their business. Business process planning plays a very important role during this position. Visualizing the causes of operations, we improve the understanding of our business capabilities, even if they are your characteristics and your flaws. This, in turn, makes you create your business more productively¹. Business process mapping is often called a business process visualization, which consists of a top-down view and explains how the business operates. The main advantage of process planning is reflection¹.

¹ (Dinis-Carvalho, Jose, et al, 2019)

1.2 Types of Business Process Maps

Process Flowcharts: A process flowchart is made and used to comprehend the essentials of any business. A process flowchart can highlight a few factors that decide the destiny and subtleties of the organization². Thusly, it additionally assists with developing generally speaking information with respect to the structure of the business.

Swimlane Diagram: This one works indistinguishably such as a non-exclusive flowchart. The first contrast, notwithstanding, is that with the Swimlane diagram, every one of the means is split between various groups or those who are accountable for them. This makes it an unmistakable framework for measures that ought to be delineated².

Value Stream Map (VSM): It is a vital tool and is usually utilized in lean six sigma applications and provides way more detail into a process. This makes them conceivably more helpful for a more top to bottom investigate a process, yet additionally makes them less normally utilized².

SIPOC: It stands for Suppliers, Inputs, Processes, Outputs, and Customers. The explanation for utilizing this tool is to indicate the importance of customer needs and cycle outputs being the equivalent².

2. Problem Description

The problem scenario is to create NPI process maps for better visibility of end-to-end processes. Businesses and organizations use process mapping so as to enhance their efficiency and productivity³. By using process maps, we gain knowledge into a process, and also it helps teams conceptualize thoughts for continuous process improvement and eventually increases the correspondence and provides documentation of the method. Process mapping will distinguish bottlenecks, reiteration, and postponements.

2.1 Challenges faced when mapping business processes

- Undefined business processes.
- Organization silos.
- Incomplete performance measures.
- Unmanaged data.
- Indistinct deliverables.
- Obscure own internal customers.
- Missing performance feedback and review³.

2.2 Benefits of using Business Process Maps

- Empowers everybody to see the method correspondingly.
- Goes about as a preparation and instructive tool for brand new and existing staff and help decrease procedural mistakes³.
- Centers stakeholders round the process itself.
- Fabricates understanding between cross functional work zones.
- Gives a "current state" whereon to base future enhancements.
- Recognizes target estimations and metrics for continuous assessment and future improvement exercises.
- Recognizes existing workarounds, revamp circles and data holes.
- Shows open doors for improvements.
- Improves consistence with, or give documentation to, quality and administrative standards³.

2.3 The Framework of Business Process Mapping

2.3.1 Recognize your organization's accepted procedures

A business process must be mapped in accordance with the standards and therefore, the organization must review what's mapped and also the extent of every process map. The process should be handily perceived as mapped by somebody who isn't near it. Each process must have the aim of why it is being done and what is going to be the end result of it⁴.

² (Dadashnejad, Ali-Asghar, and Changiz Valmohammadi, 2019)

³ (Munoz, Daniel Cobos, et al, 2020)

2.3.2 As-is

The explanation for mapping the activity must always be characterized and also the starting and closing point of the activity should be examined. Following choosing a process, decide all the means in it, including information sources and yields. Build up the frameworks, jobs, and time included. Select a process procedure⁴. Meeting the contributors for the jobs they play simultaneously, taking a gander at each obligation and selection point. Each process must have the subsequent standards: “Objectives, Activities, Inputs, Outputs, Customers, Risks and controls, and Key performance indicators (KPI’s)”⁵.

2.3.3 Examine and evaluate

The most important thing to do is to review process maps. We should decide on a process for every section, and where precisely we can actualize it. Then, distinguish the correct individuals in order to audit the guide. Finally, we should select a process improvement plan.

2.3.4 To-be

Utilizing the prescribed procedures created in the first step, document the distinctions which are in the current and also in the new processes. Root cause analysis techniques should be used to uncover possible issues⁵.

3. Solution Methodology

In this study, we used “PDCA (Plan-Do-Check-Act)” project planning tool combined with ‘PMBOK6 (Project Management Body of Knowledge): Project Management Methodology’ to map the business processes and for effective completion of the project within the schedule.

The PDCA cycle simplifies the structure of iterative improvement. It is based on real testing and it also allows teams to sift through information and evidence to come to inferences. As it depends on a logical strategy, it tends to be viewed as a proven methodology which can be reliably used to create improvement⁶.

3.1 PDCA Cycle

The PDCA cycle is a system for critical thinking, ceaseless improvement and change. It is broadly perceived as the premise of consistently improving the nature of cycles, products, and administrations. It is a memorable simple four intelligent grouping steps: Plan, Do, Check and Act. It gives a basic and organized methodology for tackling quality-related issues. Different emphases of the PDCA cycle might be important to take care of the issue forever and arrive at a definitive objective state⁶.

The PDCA cycle is especially powerful when planning to roll out minor improvements to a cycle and when the answer for the issue is known. It permits to check the attainability of a proposed thought whether it is a gradual or an advancement improvement. Rehashing the PDCA cycle oftentimes will help executing Kaizen and other continuous improvement activities. Furthermore, TQM, the ISO standards and the A3 thinking process are totally based around the PDCA theory.

Utilizing the PDCA cycle empowers the deliberate method of critical thinking and executing solutions. It guarantees that you plan, test and fuse input before you start full-scale execution. This carries you closer to your objectives as information is expanded from tackling issues, from disappointments, and from the feedback received. It additionally improves the basic thinking abilities about your group and causes your organization to reach towards a more incorporated framework.

The accompanying rows depict the four phases of the PDCA cycle:

- **Plan** – A much characterized project plan gives the system from which to work. Significantly, it ought to mirror the organization’s central goal and qualities. It ought to likewise plan the task’s objectives and unmistakably demonstrate the most ideal approach in order to meet the goals⁷.
- **Do** – This is the development in which the plan is put into practice. It was designed for explanation, so it is important for the player to follow the instructions⁷. The initiative can be divided into three sub-sections, which include preparation of all team members involved in the project, actual work cycle, and review of experience or record.

⁴ (Palmer, John, et al, 2020)

⁵ (Shaikh, Shabina, and Arabella Bhutto, 2019)

⁶ (Marshall Hargrave, 2019)

- **Check** – To begin with, checks should be done close to execution to ensure that the task's goals are being met. Second, a more far-reaching survey of the undertaking should be done upon finishing to take into consideration victories and disappointments to be addressed.
- **Act** – Once past errors have been identified and represented, you can re-rank the PDCA cycle and try again later, probably to get better results under the new rules⁷.

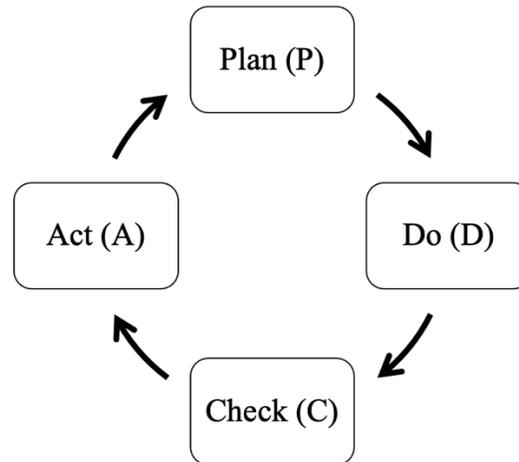


Figure 1: PDCA Cycle

It has been found that the use of PDCA cycles is far more feasible than adopting the "right from the start" approach. Finding the best techniques for improvement using the PDCA cycle requires constant effort. The PDCA cycle can be applied to both responsible care and program processing. Corrective action comprises of two different types, the first one is temporary and the second is permanent⁸.

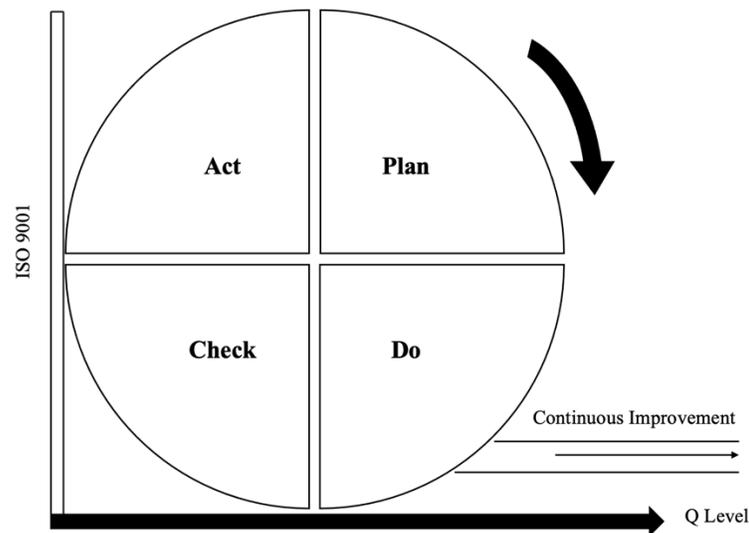


Figure 2: PDCA cycle in continuous improvement process

⁷ (Chojnacka-Komorowska, Anna, and Sebastian Kochanicc, 2019)

⁸ (Abadi, I, et al, 2019)

The interim measure focuses on outcomes by addressing the problem and its solution. The permanent corrective action consists, again, of examination and elimination of the foundation and thus focuses on supporting the enhanced cycle⁸. Some portion of the PDCA cycle applies to inside quality affirmation techniques.

- What are you attempting to accomplish?
- How do you see change as improvement?
- What changes are you willing to make?

Figure 1 illustrates the PDCA cycle. Within the Do phase or implementation phase, the resolution of the problems used is expected to involve a shorter PDCA cycle than normal.

There are a few things outside of the PDCA cycle device. Much of the PDCA is in the later "action" phase of the task when the cycle begins to improve again⁸.

4. Case Study

The principal fundamental goal of process mapping is for companies to acquire a comprehension of the entirety of the means engaged with a specific process. A process map is customarily drawn on a huge piece of paper; nowadays, programming programs are accessible. The visual outline assists organizations with understanding what steps are engaged with each cycle. It likewise encourages them picture how each progression cooperates with other advance inside a similar cycle. A process map is imparted to workers to instruct them about the means and how each progression fits in to the cycle. Organizations use process mapping to decide how great the presentation is with a specific interaction. By examining a visual picture of the interaction and its means, a company can check whether the cycle is being led proficiently and legitimately.

The company selected for the case study is GlobalFoundries (GF). GF is considered to be one of the world's leading semiconductor foundries. GF offers some of the world's most innovative technologies offering fabrication and turnkey services. GF makes possible the innovations and systems that disrupt industries and give consumers the power to influence their business with a global manufacturing presence spanning three continents. In this case study, we will see some of the NPI processes and their process maps.

In this case study, PDCA cycle was deployed. In the upcoming sections, we will see how PDCA cycle was used to complete this project successfully.

4.1 Plan phase

The Plan phase consists of four phases. Planning phase is the roadmap for a project. The step-by-step process for planning a project is listed below.

P1. Conception and Initialization

Vision statement: Define process boundaries, process ownership, process responsibilities and effective measure or process metrics and improve efficiency of organization.

Mission statement: To create and publish level 2 process maps for "Finalize Post-Fab Requirements", "Wafer & Module Test New-Product-Introduction", and "Packaging New-Product-Introduction".

P2. Definition – Goals, Objective, Scope

Goal: To create NPI process maps for better understanding of the flow of a process and making processes more visible across the business.

Objective:

- Create process maps.
- Validate the flow with the process owners and team.
- Document the process flows in accordance with ISO 9001 Quality Management System (QMS) standards.
- Publish the models.

⁸ (Abadi, I, et al, 2019)

Project Scope:

- Provide perception into a process.
- Aid teams brainstorm ideas for process improvements³.
- Increase communication as well as provide process documentation.

P3. Planning – Overall Project Schedule

The overall project schedule depicts the overall time taken to complete this project, the start and end dates of each process that was mapped out, and the number of days taken to map out each process. Figure 3 represents the overall project schedule structure.

Gantt chart was deployed which is one of the important tools in project management. It is very useful for project planning as well as scheduling. Figure 4 demonstrates the Gantt chart for this project.

PROJECT NAME: NPI Process Maps in Aris	PROJECT DURATION: 40 Days	START DATE: Nov 09, 2020	PROJECT END DATE: Dec 18, 2020
---	----------------------------------	---------------------------------	---------------------------------------

Process ID	Process Description	Start Date	End Date	% Completed	Days
1	Gather & Finalize Testing Requirements	11/05/20	12/15/20	100%	37
2	Define Product Specific Test	11/07/20	12/16/20	100%	38
3	Define Qualification Requirements	11/08/20	12/14/20	100%	36
4	Create a quote for assembly	11/09/20	12/10/20	100%	32
5	Develop NPI prototype	11/10/20	12/16/20	100%	38
6	Transfer NPI prototype to production	11/12/20	12/16/20	100%	38

Figure 3: Overall Project Schedule

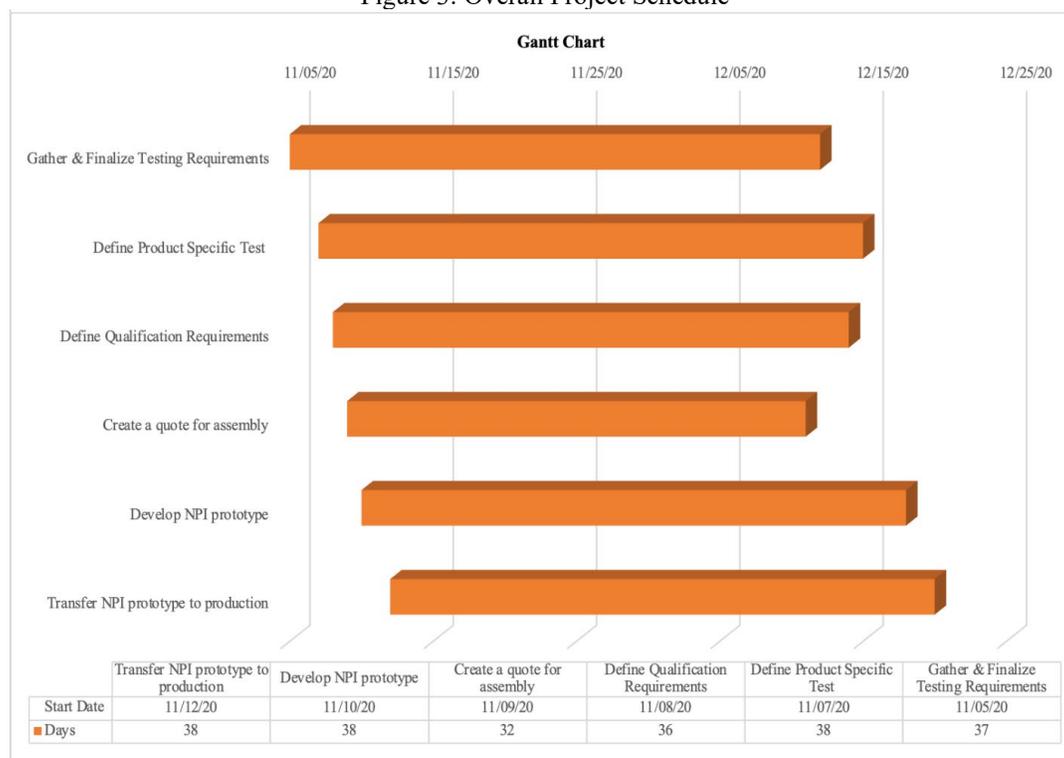


Figure 4: Gantt Chart

³ (Munoz, Daniel Cobos, et al, 2020)

P4. Planning – Stakeholders

Following, inside the Plan stage it is additionally imperative to speak with the stakeholders the objectives for actualizing the Business Process Maps. Stakeholders' obligation to the project is fundamental since their interest and feedback will give a linkage towards continuous improvement and the creation and accomplishment of the current and future state maps⁸. For this situation, the aim and significance of Business Process Maps execution was brought out through a correspondence crusade that included departmental meetings and stakeholder briefings.

No	Process	Process Owner	Team Members	Outlook	Links
1	Gather & Finalize Testing Requirements	XXX	XXX	Dec 15, 2020	https://gfoundries.a
2	Define Product Specific Test	XXX	XXX	Dec 16, 2020	https://gfoundries.a
3	Define Qualification Requirements	XXX	XXX	Dec 14, 2020	https://gfoundries.a
4	Create a quote for assembly	XXX	XXX	Dec 10, 2020	https://gfoundries.a
5	Develop NPI prototype	XXX	XXX	Dec 16, 2020	https://gfoundries.a
6	Transfer NPI prototype to production	XXX	XXX	Dec 16, 2020	https://gfoundries.a

Figure 5: Stakeholders List

4.2 Do phase

The subsequent stage is to test our speculation (i.e., our proposed solution). The PDCA cycle centers around more modest, steady changes that help improve processes with negligible disturbance.

4.2.1 Execution – Process Map

The above listed NPI processes for Post-Fab services was successfully mapped out. The process maps covered all the processes right from preparing Request for Quotations (RFQs) to High Volume Manufacturing (HVM). The rough overview of ‘Transfer NPI Prototype to Production’ process which comes under ‘Packaging New Product Introduction’ is shown below.

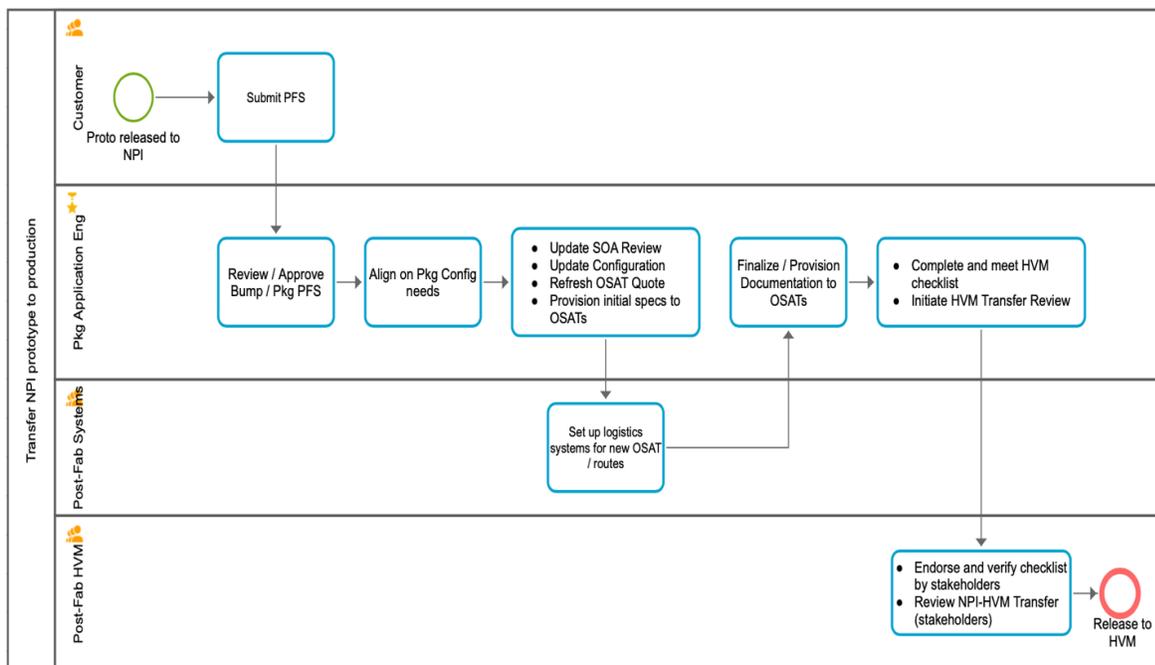


Figure 6: ‘Transfer NPI Prototype to Production’ Process Map

⁸ (Abadi, I, 2019)

4.2.2 Software

ARIS stands for Architecture of Integrated Information Systems. This software was employed to map the business processes during this case study. ARIS could deal with enterprise modelling. It provides techniques for analyzing cycles and taking an omnipresent approach to process design, management, work processes, and application preparation⁹. ARIS envisions the installation of the ARIS Toolkit Enhancement Modeling (ARIS) programming framework. The ARIS design tool is generally known as a tremendous business process modeling tool. It is consistent with the terms and conditions of its unique business 'requirements'. ARIS Toolkit Vendor Software is the leading business process management tool developed and managed by AG⁹. ARIS provides several simple reports; however, they follow the general ARIS design with the SAG organization and labeling. ARIS customization provides a compiled compiler in terms of report module code to create custom ARIS reports captivated by the subordinate ARIS JavaScript⁹.

4.3 Check phase

In this phase, we have reviewed and analyzed the results. This phase is significant as it permits us to assess our solution and reexamine our plans as fundamental.

4.3.1 Project Deliverables

The most prominent project deliverables obtained from this project are listed below.

PROPOSED DELIVERABLES	PUBLISHED IN ARIS
Gather & Finalize Testing Requirements	
Define Product Specific Test	
Define Qualification Requirements	
Create a quote for assembly	
Develop NPI prototype	
Transfer NPI prototype to production	

Figure 7: Project Deliverables

4.4 Act phase

In the Act phase, we have defined the outputs assumptions of the process maps and also the standard operating procedure for mapping the processes.

⁹(Tbaishat, Dina, 2018)

4.4.1 Output Assumptions – Process Maps

- Showed visibility of end-to-end processes.
- Showed who is responsible and accountable for activities and who owns the overall process.
- Identified and mitigated risk.
- Supported operational excellence.
- Showed compliance and continual improvement.

4.4.2 Standard Operating Procedure (SOP) – Process Mapping

A Standard Operating Procedure (SOP) is an important document which contains a set of instructions on how to perform a particular task. Figure 9 shows the step-by-step procedure for mapping the processes.

Process:	How to Publish Process Maps in ARIS
Process Number	Process Description
1	Complete 1 st draft
2	Validate the flow with process owner and team
3	Check whether it complies with ARIS standards
4	Publish the model
Prepared by:	
Created on:	12/17/20
Updated on:	
Approved by:	
Pending Approval:	

Figure 8: SOP for Process Mapping

5. Summary and Conclusion

In this paper, we understood an overview of different types of business process maps, their benefits, etc. which was followed by a case study using PDCA cycle for mapping business processes. The underlying mechanisms, tests, and input mechanisms of PDCA enable decisions and improvements during the usage phase of the cycle. The PDCA cycle divides the enterprise into small rational advances and allows for slow, gradual upgrades. PDCA is used for solving problems at all levels of the enterprise. Before moving to a larger area, it is useful to look up different answers to the question and test it in a controlled environment.

References

- Dinis-Carvalho, Jose, et al., "Waste identification diagram and value stream mapping: A comparative analysis"., *International journal of lean six sigma*, vol.10, no. 3, pp. 767-783, 2019.
- Dadashnejad, Ali-Asghar, and Changiz Valmohammadi., "Investigating the effect of value stream mapping on overall equipment effectiveness: a case study"., *Total Quality Management & Business Excellence*, vol.30, no. 3-4, pp. 466-482, 2019.

- Munoz, Daniel Cobos, et al., "Better data for better outcomes: the importance of process mapping and management in CRVS systems"., *BMC medicine*, vol.18, no. 1, pp. 1-10, 2020.
- Palmer, John, et al., "Mapping key process parameters to the performance of a continuous dry powder blender in a continuous direct compression system"., *Powder Technology*, vol.362, pp. 659-670, 2020.
- Shaikh, Shabina, and Arabella Bhutto., "Process mapping and rating of banking activity from knowledge management perspective"., *Indian Journal of Science and Technology*, vol.12, no. 18, pp. 1-11, 2019.
- Marshall Hargrave, PDCA Cycle, Available: <https://www.investopedia.com/terms/p/pdca-cycle.asp>, Accessed in 2019.
- Chojnacka-Komorowska, Anna, and Sebastian Kochaniec., "Improving the quality control process using the PDCA cycle"., *Prace Naukowe Uniwersytetu Ekonomicznego we Wroclawiu*, vol.63, no. 4, pp. 69-80, 2019.
- Abadi, I., et al., "The consciousness of excellent quality service to improve effectiveness of TQM and kaizen-PDCA quality management". *IOP Conference Series: Earth and Environmental Science*, vol. 343, no. 1. p. 012138, IOP Publishing, 2019.
- Tbaishat, Dina., "Process architecture development using Riva and ARIS: comparative study"., *Business Process Management Journal*, vol. 24, no.3, pp. 837-858, 2018.

Acknowledgements

The authors would like to thank Dr. Nagendra N. Nagarur, Professor of the Department of Industrial and Systems Engineering at Binghamton University for his guidance throughout this project.

Biographies

Arun Kumar Kathirvel graduated from Binghamton University, State University of New York with a Master's in Industrial and Systems Engineering.

Carolyn Paddock-Moore is a Post-Fab NPI & CPI Program Manager at GlobalFoundries. She has been responsible for program management for Specialty Foundry Client programs, collaborating with quality, manufacturing, technology development, supply chain and sales to meet the client's needs in the marketplace for the last 6 years.

Shiladitya Chakravorty is a Factory Automation Engineer at GlobalFoundries. He has been working in the areas of semiconductor shop floor scheduling and dispatching and factory automation for the last 10 years.