CHAPTER 5

CONCLUSION AND FUTURE SCOPE OF WORK

5.1 CONCLUSION

NPD management process fundamentally drives businesses today. NPD success has costs associated with it as it has brings with it certain complexities and risk-intensity. Hence the success of the NPD management process strongly relies on the all the constituents of the organization as well as the major stakeholders.

The successful implementation needs coordination and cooperation among the various functions and departments. Moreover, behavioral environment of the company, culture, commitment of adequate resources and top-management full commitment are necessarily important to the successful NPD.

The study reconciles the deliverables that are needed for effective product production launch and the reflection analysis provides insight on the positives happened in the NPD Program and improvements that are needed as lessons learned in future programs. The results of this study determine how systematic adherence of New Product Development Management process at Caterpillar for the introduction of 40/50 ton rear dump trucks has paved way for the successful production launch of its products and how Caterpillar 40/50T products were subjected to competitive benchmarking with similar
class products of competitors and emerged superior over competitors with regard to product performance and reliability.

5.2 OUTCOME OF NPD MANAGEMENT PROCESS

The NPD process successfully incorporated various improvements in the basic design of the off-road trucks as shown in the Figure 5.1. This section discusses the results of the successful implementation that has brought several changes in various parts of the final product.

5.2.1 Cabin Design

The NPD management process suggested various design improvements in the basic cabin design. The suggestions for design improvement and the incorporated design features in the new developed machines are listed in the following phrase.

- The new design incorporated tilted cab which has many advantages including improved engine access, a much shorter wheelbase, increased length of cargo and overall shorter length, better visibility, better access to the engine by tilting the cab, better driveability and easy parking.
- Enhanced design has updated the styling remarkably.
- Operator comfort is ensured in the modified design.
- Improved mounting has enhanced the look of the basic machine.
- Powered Mirrors were provided to improve the rear view.
- Powered LH window provides better comfort.
- Sliding / Hinged RH window.
5.2.2 Improvements in Transmission

Improvements in the transmission system included following features.

- The system introduced the integrated Transmission system which resulted in better cost reduction and weight reduction.
- Improved shifting has also been ensured due to better ECPC and shift control logic.

5.2.3 Improvements in Manufacturing Process

Due of improvements in manufacturing process, an updated machine assembly line was utilized in the existing source plant. A new machine assembly plant was setup in the facility in India.

5.2.4 Improvements in Body

The NPD process ensured that the body of the machine is modified in such a way that overall weight has been reduced and thicker floor was designed to withstand the load shear.

5.2.5 Improvements in Engine & Cooling System

The modified engine and cooling system included features like Tier 2/3/4F compliant engine. New cooling package which resulted in better weight reduction and cost reduction.

5.2.6 Improvements in Structures

The improvements in the structure of the machine due to the proposed NPD process included a simplified all welded main structure, reduced weight and lower cost structures.
5.2.7 Improvements in System Integration

The successful NPD process resulted in improved performance and better fluid level tracking, and finally economy mode of machine operation.

![Figure 5.1 Major Outcome of NPD Program]

5.3 NPD ACCOMPLISHMENTS

This section of the thesis discusses the major advantages of the NPD process in Caterpillar Inc. The overall accomplishments of the NPD management process (Figure 5.2) are described below.

5.3.1 Reliability

The successful NPD management process enhances the reliability of the trucks to a great extent. The results of the evaluation show that the developed machine has better mDRF of 0.0995 and VEHR of 0.2675.
5.3.2 Profitability

NPD ensures that the profitability of the products is better which as evident from positive NPV values. IRR was found to be 16%.

5.3.3 Durability

The economic life of the trucks was calculated as 40,000 hrs which ensures better durability and value for money.

5.3.4 Regulations

NPD process ensures that the developed system adheres to various regulations such as Tier 2, 3 & 4 Final, Visibility (ISO 5006) and Braking (ISO 3450).

5.3.5 Performance

NPD resulted in improved shift quality and improved fuel efficiency.

5.3.6 Safety

The resulting machine has improved brake slope holding capability, better tire protection feature, provision for seat belt detection and ground level access.

5.3.7 Owning & Operating Cost

Owning and operating costs of the proposed machine were lower due to economy mode of operation. The additional features included fluid level monitoring, tire protection feature and extended life filters.
5.3.8 **Machine Availability**

Virtual Validation, 2 phase build and Failsafe design ensures the guaranteed machine availability in the proposed NPD process.

5.3.9 **NPI Program**

The values for PCI, APQP, RMI and CPPD Effectiveness were well above 0.9 because of successful NPD program.

5.3.10 **Operator / Environment**

The NPD program ensures better operator/environment through keeping low cab sound level in decibel [72 db]. In addition, powered mirrors and powered LH window ensures better operational environment. Automatic temperature control is also available in the design.

![Figure 5.2 NPD accomplishments](image.png)
5.4 LESSONS LEARNT

Every new project opens a door for new learning. A successful organization never stops to learn. Sustained learning brings competitive advantage to the organizations in effectively meeting the customer demand and providing better services. The lessons learnt in the NPD program of 40T and 50T off-highway trucks is documented and is discussed in this section.

1. Adopt revitalized NPI early in NPD management program.

   The NPI process can be handled better by appointing a NPD Manager from start of program.

   It is always advantageous to understand milestones and work back from the closest gateway to schedule date upon arrival.

   Always ensure that schedule accurately reflects NPI requirements because unrealistic schedule will often produce undesirable results.

2. Better utilize NPD tools.

   NPD assessment tools can be used proactively to visualize the results quickly.

3. Team member training.

   Always ensure that members receive adequate training on processes and tools.

4. Make commitments based on data.

   It is important to understand the capability and then set stretch target for commitment.
5. It is suggested that believe the importance of NPD schedule that are preplanned and follow the schedule properly to see better results.

6. It is recommended that always ensure all required options in the NPD processes are properly understood and released when needed.

7. CPPD (Concurrent Product and Process Development) requires to ensure all teams have all the relevant data required and understand whom to go to if they don’t have the data.

8. Ensure that the needed NPD tools are understood and put into place during NPD program.

9. Ensure that all resources are in place and engaged prior to launch of the program. Successful programs require that all resources are available and easily approachable.

10. It is recommended that the potential problems of software system integration are taken into account. Sometimes software applications working in an environment may not be compatible with legacy systems in other environment.

11. It is suggested that wrong assumptions regarding the availability of parts will result in unnecessary delay. Similarly availability and delivery of all components has to be closely followed.

12. It is recommended that service parts should not be used for production.
13. It is critical that adequate time is allowed for supplier selection & development. Supplier development has to be given utmost importance before ordering from the supplier. Adequate back up plans should be in place if something happened with supplier development.

14. It is judicious to make ensure that all potential issues are discussed early and not held until dates have come and gone.

15. Ownership of design, warranty, etc. needs to be clearly identified to drive correct behavior for component process changes.

16. Need to ensure common goals between design group, operations, and purchasing departments.

17. It is more than important that all the processes are defined/proven earlier in program.

18. Finally, it is important that always set realistic build schedules based on scheduled component arrival dates.

5.5 SCOPE FOR FUTURE RESEARCH

The present study is the base for many studies to follow. The Reflection Analysis opens the door for many research works for young scholars. The lessons learnt from the new production development process provides opportunities to look for new avenues and methodologies for improvement of the effectiveness of the NPD Management process and reduction of the lead time for NPD programs. The Production Studies provide base for further studies with other competitor models and improve value
selling in the growth markets. The study also provides ample opportunities for future study in effective ways of handling and managing Engineering changes and implementation. Reliability issue analysis of machines deployed in mines for validation sets up new platform for young scholars to effectively capture, analyze and manage customer issues.