INTERNATIONAL JOURNAL OF RESEARCH AND SCIENTIFIC INNOVATION (IJRSI)
ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue VI June 2026

Performance Assessment of the Developed Change Oiling Machine

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DOI: https://doi.org/10.51244/IJRSI.2026.1306000532

Received: 08 July 2026; Accepted: 13 July 2026; Published: 24 July 2026

ABSTRACT

This study aimed to assess the performance of the new developed machine for change oiling of automobile's engine.The machine is a semi-automated, 12V DC-powered system specifically designed to optimize and simplify vehicles' oil removal and refilling process.The performance activity was conducted through various types and models of vehicles. The revealed data in each of the performance activity is in consonance with the expected output and standard operation of the machine. Hence, the new developed oil changing machine is recommended for its widely used in automotive industries, technology schools, local automotive shops or service center, and owners of vehicles.

Keywords: new developed change oiling machine assessment,oil changer machine testing.

INTRODUCTION

Technology today is evolving unprecedentedly, fundamentally altering how societies function and adapt. These groundbreaking innovations are being introduced swiftly, quickly, embraced, implemented, and integrated into daily life. This swift adoption signifies how deeply embedded technology has become in shaping both societal behavior and global progress.

As lifestyles rapidly evolve, nations worldwide experience constant change, often marked by uncertainty. This flux was particularly evident during the COVID-19 pandemic, which catalyzed the emergence of a fully digital environment. Like other countries, many sectors in the Philippines were abruptly thrust into digitalization, leaving employees and workers to navigate unfamiliar technological landscapes. While the pandemic brought significant challenges, it also spurred positive behavioral shifts as people began to accept, adapt to, and enjoy new technologies.

Ventura (2017) supports this observation by asserting that technological advancements have significantly enhanced modern life. These innovations have brought comfort, convenience, and satisfaction to people's lives. Indeed, the marvels of modern technology have become an essential part of daily living, easing burdens and streamlining routines for individuals across the globe.

Technological innovations continue to be a vital force in shaping modern society. They evolve rapidly that today's most advanced tools may become outdated within months. As noted in the Collins Dictionary (2016), technology is a practical application of scientific knowledge involving tools, systems, and procedures designed to meet human needs and resolve problems. Moreover, the transformative power of human ingenuity to reshape nature for societal benefit is a fundamental driver of socio-economic change, as highlighted by Storper and Walker (1989).

In the modern workplace, technology enhances convenience by streamlining tasks, increasing productivity, and promoting the delivery of efficient services (Convenience, 2014). Technological innovation is not limited to developing new products; it also involves optimizing production processes and reducing costs. As Meineke

(2020) points out, this approach is evident in automobile manufacturing, where companies strive to innovate while minimizing operational expenditures continuously.

The rapid advancement of transportation technology further supports the urgency of this study. Vehicles have become necessities rather than luxuries, yet they are prone to wear and tear. Routine maintenance ensures roadworthiness and extends the vehicle's life span.

Maintenance plays a critical role in ensuring the longevity and safety of vehicles. According to the Reliability Academy (2021), the core philosophies of vehicle maintenance—preventive, predictive, and breakdown maintenance—serve as essential strategies for preserving vehicle components. Among these, preventive maintenance is the most vital, as it helps avoid accidents and extends the life of engine parts.

One of the most critical elements of vehicle maintenance is engine oil management. Regular oil changes are necessary for optimal engine performance and fuel efficiency. Crouse and Anglin (2010) emphasize that consistent oil maintenance keeps the engine in good condition, enhances performance, and ensures that vehicles remain roadworthy.

Replacing old oil with fresh, preferably synthetic oil, prevents sludge buildup in the engine. Synthetic oils, particularly those with multi-viscosity properties, are more effective than single-viscosity oils. Oil viscosity is crucial in adjusting to various engine temperatures—cold, hot, or extremely hot. Single-viscosity oils cannot adapt effectively to these fluctuations, increasing wear and tear on engine components. In contrast, multi-viscosity oils adjust from thin to thick or vice versa, depending on temperature changes. These viscosity ratings, regulated by the Society of Automotive Engineers (SAE), are clearly labeled on oil containers (Gilles, 2019).

Thus, routine oil changes enhance engine performance and support environmental sustainability. This practice is aligned with the **Replacement Theory**, which emphasizes determining the optimal replacement time for parts and materials to minimize total costs. Vehicle manufacturers support this approach by providing owner's manuals that specify oil change schedules based on mileage (e.g., 1,000 km, 3,000 km, 5,000 km, etc.) or time intervals (e.g., 3, 6, or 12 months) (Toyota Car Owner's Manual, 2024).

However, used engine oil is classified as hazardous waste. According to Dinesh et al. (2021), automotive lubricating oil is a highly polluting substance requiring responsible disposal. Improper disposal can contaminate soil and groundwater. In line with this concern, the DENR Administrative Order No. 2013-22 mandates the regulation of chemical substances and mixtures that pose risks to health and the environment, including used oil (Supreme Court E-Library, 2013).

Despite advancements in vehicle technology, the oil change procedure remains largely mechanical. The conventional method involves lifting the vehicle with a jack or lifter, removing the oil drain plug using hand tools, and allowing the oil to drain into a pan (deKryger et al., 1986). Although widely practiced, this process is labor-intensive, messy, and potentially hazardous. Technicians and students performing this task face risks, particularly when working underneath lifted vehicles. Equipment malfunctions can lead to serious injuries or fatalities. Most small and medium-sized shops still rely on this traditional process, while larger car companies use advanced hydraulic lifts.

Modern automotive industries have adopted new technologies to address these challenges and enhance the oil-changing process. Such is the replenishment of engine oil which has already technological advancements. New oil extractors now allow oil to be drawn from the oil bank and inserted directly into the engine refill hole (Kassa, 2018). Standard models include the OEM Tools Manual Fluid Extractor, HT Moto Oil Extractor, Performance Tool Electronic Oil Extraction Pump, EWK Pneumatic Oil Extractor, and the Air Power America Flotool Topsider Pump (Motor1, 2024).

Naturally, new technologies were undergo rigid evaluation to comply with operating standard. Hence, the present developed change oiling machine performance assessment activity was conducted on this study.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue VI June 2026

Statement of Objectives

Generally, the study aimed to assess the capability of the developed change oiling machine. Specifically, it seeks to achieve the following:

1. To provide the features of the developed change oiling machine;
2. To conduct performance tests of the developed change oiling machine compared to the existing oil changing method in terms of:

2.1 Time spent for removing used oil from the engine;

2.2 Time spent for refilling new oil to the engine; and,

2.3 Volume of extracted oil.

Time and Place of the Study

The assessment activity was undertaken at the College of Industrial Technology, Mariano Marcos State University, Laoag Campus, City of Laoag, Ilocos Norte, during the academic year 2024-2025.

Significance of the Study

The assessment activity of the developed oil changing machine served as evidence of quality and readiness of the machine to be commercialized. Also, it helps the maker or inventor to polish the machine to its near-perfect mode and function.

Definition of Terms

The following are the operational terms used in this study.

Change Oiling Machine . This refers to the developed machine which is an innovative, semi-automated, 12V DC-powered system designed to optimize and simplify the process of changing oil in automobile's engine.

Traditional Oil Changing Process. This refers to the typical or common way of removing and refilling oil of a motor vehicle's engine which usually involves manual tasks such as but not limited to; lifting a vehicle; removal of the oil pan nut; draining the used oil of the engine; and, manually pouring a new/fresh oil in the engine.

Change Oiling. This refers to the process of removing/extracting/draining of used/old oil of the automobile and replenishing/refilling new/fresh oil on it using the developed change oiling machine and existing common method.

Engine Oil. This refers to the new and used oil of the engine of motor vehicle.

Performance Test. It refers to the static and dynamic testing of the machine during and after fabrication.

Descriptive Test. This is to assess and quantify the performance of the developed machine.

Operating Manual. This refers to a document prepared by the researcher which provides users with essential information on the developed oil changing machine operation, including safety protocols, proper device manipulation, and detailed preventive maintenance procedures.

METHODOLOGY

Research Design

This study utilized descriptive research design. Moreover, the research and development approach aims to create a product or system and assess its effectiveness (Sugiyono, 2014; Domingo, 2023). Mendoza (2023) cites Kotari (2016) and Baraceros (2016) in asserting that descriptive research includes surveys and fact-finding inquiries of various types. Developmental research is important in instructional technology and commonly focuses on analyzing, describing the product-development process, and evaluating the result. In the context of technology innovation, the developmental research process is relevant.

Sources of Data

Various types of vehicle were used as the model for conduct of performance assessment activity for the developed Change Oiling machine (COM). The COM performance was compared with the common way or traditional way of change oiling a vehicle using the different types and models of automobiles. All the data gathered were recorded, tabulated, and analyze by the researcher with the assistance of professional statistician.

Data Gathering and Analysis

To machine was subjected to performance assessment activity by a comparison with the existing or traditional method of changing the oil of an engine of a vehicle, specifically the time spent in removing used oil, time spent in refilling new oil, and volume of the used oil removed from the engine. The comparison was determined through the difference in time spent in removing and refilling oil and the difference in measurement of the removed used/old oil.

The mean was used to determine the descriptive categories to the tabulated data gathered during the performance assessment of the machine. The following formula was used to determine the mean:

$$\bar{x} = \frac{\sum x}{n}$$

where:

$\bar{x}$ = mean

$\sum x$ = sum of all the individual data values

n = total number of respondents

RESULTS AND DISCUSSION

Features of the Developed Oil Changing Machine

The OCM is an innovative, semi-automated, 12V DC-powered system designed to optimize and simplify changing oil in motor vehicles. The machine promotes the safe art of the oil change process. Its principle of operation was patterned with the existing oil exchange machines like the Automatic Transmission Fluid (ATF) exchanger that automotive technicians use to perform automatic transmission fluid (ATF) exchanges (SmartSafe, 2023), particularly the Smart 550 and 900 Change Oiling Machine for two and four wheels. It is fabricated from light but tough materials such as stainless sheet and steel, which is suited for the change oiling process. Unlike traditional/typical methods, this advanced system eliminates the need for lifting the vehicle or removing the oil pan drain plug, reducing labor-intensive tasks and minimizing potential safety risks which most of the activity in oil changing are present in such typical/traditional way of removing and refilling oil of a motor vehicle (Thompson, 2019). It is also noted that the Change Oiling Machine has a better edge than the various ATF exchanger machines, wherein this oil exchanger focuses on extracting and refilling automatic transmission fluid. Hence, they are not intended to remove and refill the engine's oil.

Furthermore, the Change Oiling Machine offers quick and efficient extraction of the used oil of motor vehicles and precise oil replenishment while ensuring a clean and mess-free oil change process, hence reducing oil spills and waste that may contribute to the pollution of the environment. The developed machine's ability to simplify oil changes relieves users of tedious tasks.

The figure below shows the left and right perspective view of the developed change oiling machine.

Figure 1. Perspective View of the Developed Change Oiling Machine.

Performance Assessment of the Developed Change Oiling Machine (COM)

The performance assessment of the Change Oiling Machine is prior to the construction and assembling activity of the main parts and sub-components of the machine. Testing and adjustment were conducted after assembling all the parts and systems of the machine. The machine was undergone static and dynamic testing. Static testing, also known as verification testing or non-execution testing, is a testing method that is performed in the early stage of development to avoid errors as it is easier to find sources of failures, and it can be fixed easily (GeeksforGeeks, 2024). Static can be done manually or with the help of tools to find problems and improve the system's quality.

The machines' motors were run with load and no-load tests while the researcher observed the conditions of the system. After which, all irregularities that had been observed were solved and adjusted, such as the frequent blown-up of fuses, which was solved by changing the amperage of the fuses from 10 amp to 30 amp. The pretesting activity was synchronized with the actual performance test. A sedan with a 1.5 L (1,497 cc, 91.35 cu-in) straight-four 4-stroke natural aspirated gasoline engine and 4 liters of oil capacity (Toyota 1NZ-FE – Engine Specs. (n.d.). It was utilized as a model for the performance test. The test comprised oil extraction/draining of the used oil and refilling new oil using the OCM and traditional method to observe the comparison of both processes. The performance test activity was conducted in six trials to notice further the machine's efficiency in terms of time spent in the extraction of used oil; time spent refilling new oil, and volume of extracted/drained oil.

The vehicle used for the performance test was filled with 4 liters of used oil for every extraction trial. Before the start of every trial, the engine warms up for 5 minutes, and another 5 minutes is a waiting period for the oil to subside from the top of the engine to the oil pan. During every trial's oil extraction or draining process, a timer was set to observe the time spent on every trial. The volume of extracted or drained used oil in each trial was again measured to determine the volume of used oil extracted or drained from the engine through both processes or methods (COM and Common Change Oiling). After removing the used oil from the engine, the researcher prepared the new oil and refilled it in the motor vehicle. Again, a timer was set to observe the time spent on the oil refilling process of the COM and traditional method.

The basis for observing the COM time spent in extraction is when no more oil is being extracted by the motor of the COM from the engine's oil pan. This was double- checked by removing the oil pan's drainage nut and observing if there was no more oil dropping from it. On the other hand, the basis for observing time spent removing oil through the traditional method was started during the loosening and removing of the oil pan nut under the vehicle. It drained the oil with a catching pan or basin. The basis for the timer stoppage for this process is until the last drop of oil comes out from the drainage hole of the oil pan.

The following tables shows the COM's performance compared to the traditional process of changing oil in vehicles.

Table 1. Comparison of COM and Traditional Method in Terms of Time Spent in Extracting/Draining a 4Liters of Oil from the Engine of Sedan Type, Motor Vehicle

Trials	Oil Changing Machine (hr: min: sec)	Traditional Method (hr: min: sec)
1	0:08:21	1:15:12
2	0:08:22	1:10:06
3	0:08:20	1:10:09
4	0:08:21	1:11:07
5	0:08:23	1:13:11
6	0:08:18	1:10:08
Mean	0:08:21	1:11:39

Table 1 presents the extraction/draining time for the six trials, along with the calculated mean time, for both the COM and the traditional engine oil draining method. The data reveals a striking difference in the time required for oil extraction between the two methods. The extraction method using the COM consistently demonstrated a significantly shorter extraction time, with trials ranging from 8 minutes and 18 seconds to 8 minutes and 23 seconds. The calculated mean for the COM method was 8 minutes and 21 seconds.

In contrast, the traditional draining of oil method exhibited substantially longer extraction times, ranging from 1 hour, 10 minutes, and 6 seconds to 1 hour, 15 minutes, and 12 seconds. The calculated mean for the traditional method was 1 hour, 11 minutes, and 39 seconds.

The significant difference in mean, with the COM method averaging 8 minutes and 21 seconds compared to the traditional method's 1 hour, 11 minutes, and 39 seconds, which is more than one hour, clearly highlights the time efficiency of the COM method for extracting/draining engine oil of a 4Liter sedan type of motor vehicle.

Table 2. *Comparison of* COM *and Traditional Method in terms of the Volume (L) of Engine Oil Extracted/Drained in a 4Liters-Sedan Type Motor Vehicle*

Trials	COM (Extracted Used Oil)	Traditional Method (Drained Used Oil)	Difference (COM-TM)
1	3.4900	3.4760	0.014
2	3.4910	3.4760	0.015
3	3.4900	3.4750	0.015
4	3.4930	3.4770	0.016
5	3.4900	3.4760	0.014
6 Mean	3.4910 3.4900	3.4760 3.4800	0.015 0.010

Table 2 compares the volume of engine oil extracted/drained from a 4L engine oil of sedan type motor vehicle using the COM) and the traditional method. Data reveals that the COM method consistently extracts a slightly higher volume of oil across all six trials. Specifically, the COM method extracted volumes ranging from 3.4900L to 3.4930L, while the traditional method extracted volumes ranging from 3.4750L to 3.4770L.

The "Difference" column highlights the consistent advantage of the COM method, with differences ranging from 0.014L to 0.016L. The calculated mean volume for the COM method was 3.4900L, and for the traditional method, it was 3.4800L. This indicates that, on average, the COM method extracted 0.010L more oil than the traditional method.

This consistent, albeit small, increase in extracted volume suggests that the COM method may be slightly more effective at removing used engine oil but considering the consumed time for traditional method, the COM may still considered more efficient method. The consistency in the difference across trials reinforces the reliability of this observation. While the absolute difference is small, it could be significant in terms of minimizing residual old oil within the engine.

Table 3. Comparison of COM and Traditional Method in Terms of Time Spent in Refilling3.5Liters of Oil for the Engine of Sedan Type Motor Vehicle.

No. of Trials	COM *(min: sec)*	Traditional Method *(min: sec)*
1	2:45	1:35
2	2:40	1:20
3	2:41	1:17
4	2:35	1:17
5	2:35	1:15
6	2:34	1:16
Mean	2:38	1:20

Table 3 compares the time spent refilling 3.5L of new oil using a sedan type of motor vehicle with both the COM and the traditional method. The COM refilled the new oil by extracting it from the new oil container and moving it to the engine oil filler hole via a flexible hose. At the same time, the traditional method was done manually by pouring the oil directly from the container into the mouth of the oil re-filler hole. The data consistently shows that the traditional method of refilling is faster than the COM method. Across six trials, the COM method refilling times ranged from 2 minutes and 34 seconds to 2 minutes and 45 seconds, with a calculated mean time of 2 minutes and 38 seconds.

In contrast, the traditional method refilling times ranged from 1 minute and 15 seconds to 1 minute and 35 seconds, with a calculated mean time of 1 minute and 20 seconds. The mean time difference of 1 minute and 18 seconds (2:38 - 1:20) demonstrates the time advantage of the traditional method for refilling engine oil. The consistency of the results across all six trials reinforces the reliability of this observation. This indicates that while the COM may be more efficient in extracting used oil, the traditional method proves to be more time-efficient for refilling the engine with new oil. The traditional method of refilling oil, which is pouring the oil directly into the engine re-filler hole, is usually quicker than another method, but this is messy because of the probability of oil spillage and, hence, dangerous to the engine's external system. Oil spills on parts of the engine, especially rubber parts and electronic components, may destroy or cause their malfunction (Crouse & Anglin,1993). The COM uses flexible accessories to transfer oil safely from the oil container to the engine.

To further observe the machine's capability, the researcher conducted a comprehensive trial of the performance of the COM with various types of motor vehicles, such as vans, SUVs, Pickups, motorcycles, and other small engines. The study compared the traditional method of oil changing with the COM in terms of oil removal, volume of extracted/drained oil left inside the engine, and time spent refilling new oil. The oil used in each vehicle model was drained before the test, and the researcher prepared and measured the used oil based on the standard oil capacity of each model using a digital weighing device. The extraction or draining activity using the COM and traditional method was the first part of the oil change process, ensuring a thorough and systematic approach to the study.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue VI June 2026

The basis for the time spent in removing the used oil through the COM from the engine is when there is no more used oil extracted from the oil pan of the engine, while the time spent basis for the traditional way of draining the used oil is until the last drop of oil from the oil pan hole to a catching pan. A timer was used to observe the time spent every trial of extracting or draining the used oil of each type of motor vehicle used in the trials. Extracted or drained used oil was again measured to observe the volume of used oil extracted or drained from the engine through both processes (COM and Traditional). The left oil inside the engine was determined by subtracting the extracted or drained oil from the original measurement of the used oil before it was poured inside the engine. This was done to ensure an accurate measurement of the oil left inside the engine after extraction. After removing the used oil from the engine, the researcher prepared the new oil and refilled it in each motor vehicle type. The time spent on the oil refilling process of the COM and traditional method was observed and recorded.

Table 4 compares the COM and the Traditional Method in terms of time spent extracting/draining and refilling engine oil across various vehicle types. The data demonstrates a significant time advantage for the COM method during the extraction/draining. The COM method completed the extraction process in significantly less time for all vehicle types than the traditional method. For example, for a VAN with a 7L capacity, the COM took 12 minutes and 25 seconds, whereas the traditional method took 4 hours and 15 minutes. Similar trends are observed across all vehicle types, indicating that the COM method drastically reduces the time required for oil extraction.

Table 4. Comparison of COM and Traditional Method in Terms of the Time Spent in Extracting/Draining and in Refilling Engine Oil to the Motor Vehicles (SUV, VAN, Pick up, Motorcycle and other Small Engine)

Vehicle/Engine Type	**Time (COM)**	**Time (Traditional Method)**	**Fuel Consumption (COM)**	**Fuel Consumption (Traditional Method)**
Van (7 L)	00:12:25	04:15:00	00:05:12	00:02:35
SUV (6.5 L)	00:10:11	03:47:00	00:04:51	00:02:25
Pick-up (5.5 L)	00:09:38	03:16:00	00:04:22	00:01:51
Motorcycle (0.9 L)	00:02:41	00:10:31	00:01:33	00:00:45
Small Engine (0.35 L)	00:01:26	00:10:21	00:00:46	00:00:08

In contrast, the refilling time shows a different pattern. The traditional method is generally faster than the COM method for refilling new oil. This is because the COM uses flexible hoses to transfer the oil from the oil container to the engine, which requires a distance of oil travel before it pours inside the engine. In contrast, the traditional method can be poured directly the new oil in the engine. For instance, refilling a VAN with the traditional method took 2 minutes and 35 seconds, while the COM took 5 minutes and 12 seconds. However, the differences in refilling times are far less dramatic than in extraction/draining times.

Overall, the COM method substantially reduces the time needed for used oil extraction but may take slightly longer for refilling. This suggests that the COM provides a considerable time-saving benefit, especially for the draining/extraction portion of the oil change process.

Table 5. Comparison of COM and Traditional Method in Terms of the Volume of Oil Extracted/Drained from the Engine of the Motor Vehicles (SUV, VAN, Pick up, Motorcycle and other small engines)

Vehicle Type	COM	Traditional Method	Difference
SUV with 6.5L	6.4808	6.4713	0.0095
VAN with 7L	6.9856	6.9808	0.0048
PICK UP with 5.5L	5.4907	5.4860	0.0047
Motorcycle with 0.9L	0.8963	0.8938	0.0025

Small Engine with 0.35L	0.3486	0.3458	0.0028

Table 5 compares the COM and the Traditional Method in terms of engine oil volume extracted/drained across various vehicle types, reveals a consistent trend: the COM consistently extracts a slightly higher volume of used oil compared to the traditional method. Specifically, for an SUV with a 6.5L capacity, the COM extracted 6.4808L, while the traditional method extracted 6.4713L, resulting in a difference of 0.0095L. Similarly, the VAN with a 7L capacity showed a 0.0048L difference, the PICKUP with a 5.5L capacity showed a 0.0047L difference, the Motorcycle with a 0.9L capacity showed a 0.0025L difference, and the small engine with a 0.35L capacity showed a 0.0028L difference. In all cases, the COM method yielded a greater extracted volume, though the absolute differences are relatively small. This suggests that the COM method might be slightly more effective in removing used engine oil, potentially leaving less residue within the engine.

CONCLUSIONS, AND RECOMMENDATIONS

Through this study, the researcher was able to collect and document data regarding the performance of the Change Oiling Machine (COM), which integrates various systems and serves as an innovative solution for the removal and refilling of engine oil in motor vehicles. Designed to introduce a novel and more efficient method, the COM offers a distinct alternative to the existing/common/traditional oil-changing process commonly practiced in automotive maintenance.

Conclusions

1. The Change Oiling Machine (COM) is an innovative technology for the oil-changing process. Its systems effectively and efficiently remove and/or refill vehicles' engine oil.
2. The COM significantly reduces the time needed for the oil change process compared to the common/traditional/typical method.

Recommendations

1. Facilitate the mass production of the COM to increase accessibility and maximize the benefits of its time-saving capability.
2. Institutions offering Automotive Technology programs may consider acquiring the machine and integrating them into laboratory instruction.
3. Use this research as a model for encouraging innovation among students, faculty, and inventors, and as a foundation for further development of technological inventions.

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