Data Article

Dataset for the development of a diagnostic schedule for a defective LC-195V5 CNC milling machine at FUTA central workshop

O.O. Agboola [a,b,*], P.P. Ikubanni [a], B.T. Ogunsemi [a],
R.A. Ibikunle [a], A.A. Adediran [a], B. Kareem [b], B.O. Akinnuli [a,b],
C.O. Osueke [a]

[a] Department of Mechanical Engineering, Landmark University, PMB 1001 Omu-Aran, Kwara State, Nigeria
[b] Department of Mechanical Engineering, Federal University of Technology Akure (FUTA), Ondo State, Nigeria

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ABSTRACT

The dataset represented in this article describe a diagnostic schedule for a defective LC-195V5 CNC milling machine using PERT. The efficiency of the technicians who repaired the CNC machine tools was measured based on fault location within the shortest possible time. A diagnostic schedule was developed which showed the sequential means of troubleshooting within a possible shortest time. Two approaches were employed. Forward Pass (FP), which involved the diagnosis from electrical parts through Computer (CNC) to mechanical components and Backward Pass (BP) which involved the diagnosis from computer component through electrical parts to mechanical parts. Three different levels of expertise (trials) were used for each of the mode of diagnosis and the time to diagnose each component part was recorded. Two separate PERT network diagrams were drawn based on the inter-relationship of the component parts of the machine and their Critical Paths were determined.

* Corresponding author at: Department of Mechanical Engineering, Landmark University, PMB 1001, Omu-Aran, Kwara State, Nigeria.
E-mail address: agboola.olayinka@lmu.edu.ng (O.O. Agboola).

Specifications table

Subject area	Mechanical Engineering
More specific subject area	Industrial Engineering, Production Engineering
Type of data	Tables, Figures
How data was acquired	Stopwatch, Oscilloscope, Signal generator, multi-meter, line tester, RCL tester, Neon tester, etc. were employed through the usage of Forward pass and Backward pass experiments.
Data format	Raw, processed and analysed
Experimental factors	Having studied the principle of operation of the machine using the operation manual, the machine was tested to ascertain its effectiveness. The machine was found to be faulty and then diagnosis steps were taking to detect the faults. Average expected time for both experiment were determined in which optimistic time, pessimistic time and most likely time were obtained.
Experimental features	Computational Analysis. Optimistic time, pessimistic time and most likely time data obtained from the average/expected time for both the Forward and Backward pass experiments.
Data source location	Diagnostic schedule data was obtained from the Mechanical central workshop of Federal University of Technology, Akure. (**Latitude:** 7°12'18.04" N, **Longitude:** 5°11'15.58" E)
Data accessibility	All the data are within this article.
Related research article	Agboola OO, Kareem B, Akinnuli BO. Development of a diagnostic schedule for a defective LC-195V5 CNC milling machine using PERT. Leonardo Electronic Journal of Practices and Technologies, 2016, 15 (28):107–118 [1]

Value of the data

- The dataset can be used to show the sequence of diagnosing a defective LC-195V5 milling machine and the time take to diagnose each component part.
- The data can be used to evaluate the two possible routes of diagnosis through the setting of Experiments I and II.
- The reported data can be useful for relating information on the relationship between sequence of diagnosis and time taken for the overall diagnosis of the machine as a whole.

1. Data

The dataset presented in this article are experimental results obtained from diagnosis of each component part of the CNC milling machine. The picture of the machine is as shown in Fig. 1. Stopwatch was used to record the time taken to diagnose each component. Other equipment utilized in obtaining this data are as shown in Figs. 2–7. Time to diagnose each component part using Experiments I and II are as shown Tables 1 and 2, respectively. The average/expected time and standard deviation computed for Experiments I and II are as shown in Tables 3 and 4, respectively.

Figs. 8 and 9 show the network diagram generated from Tables 3 and 4. Analytical tables used in estimating the critical path are as displayed in Tables 5 and 6 for Experiment I and II, respectively.
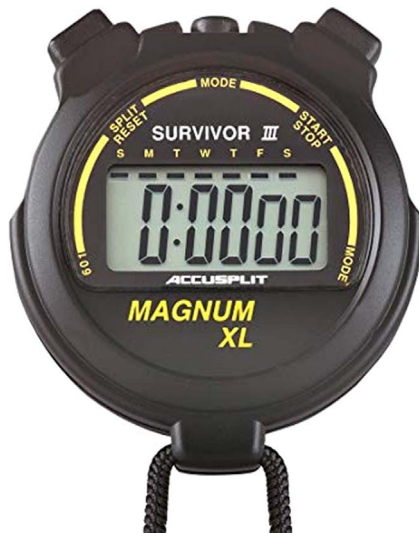
Fig. 1. Defective LC-195V5 Milling machine.

Fig. 2. Stopwatch.

Fig. 3. Signal generator.

Fig. 4. Oscilloscope.

Fig. 5. Multimeter.

Fig. 6. Line tester.

Fig. 7. Neon tester.

Table 1
Experiment I (forward pass)-diagnosis from electrical components.

S/N	Diagnosed parts	Time duration (seconds)		
		1st Trial 'a'	2nd Trial 'm'	3rd Trial 'b'
1	Testing and diagnosis of the electrical mains	698	720	732
2	Checking of the electrical cabinet of the machine	1,265	1,306	1,329
3	Checking, testing and the diagnosis of the spindle motor	1,226	1,265	1,287
4	Checking, testing and the diagnosis of the table motor	1,043	1,077	1,096
5	Testing of the actuator	1,037	1,070	1,089
6	Diagnosis of the processor	1,103	1,141	1,160
7	Checking, testing and diagnosis of the power pack	1,618	1,671	1,701
8	Checking of the CNC console	1,229	1,259	1,282
9	Testing of the coolant sensor	2,261	2,341	2,381
10	Mechanical check of the machine	1,977	2,037	2,076

Table 2
Experiment II (backward pass)-diagnosis from computer components.

S/N	Diagnosed parts	Time duration (seconds)		
		1st Trial 'a'	2nd Trial 'm'	3rd Trial 'b'
1	Checking and diagnosis of the CNC console	1,867	1,928	1,962
2	Testing and diagnosis of the processor	1,511	1,563	1,589
3	Checking and testing of the actuator	1,162	1,202	1,223
4	Checking, testing, diagnosis and the repair of the power pack	2,799	2,897	2,948
5	Checking of the electrical cabinet	2,439	2,520	2,567
6	Testing and checking of the spindle motor	1,561	1,613	1,648
7	Testing and checking of the table motor	1,273	1,331	1,356
8	Diagnosis for the mechanical fault	2,046	2,099	2,145

Table 3
Average/expected time for experiment I (forward pass).

Diagnosed parts	Time "a"	Time "m"	Time "b"	Expected Time (s)	Standard deviation
Testing and diagnosis of the electrical mains	698	720	732	718.33	5.67
Checking of the electrical cabinet of the machine	1,265	1,306	1,329	1,303	10.67
Checking, testing and the diagnosis of the spindle motor	1,226	1,265	1,287	1,262.17	10.17
Checking, testing and the diagnosis of the table motor	1,043	1,077	1,096	1,074.5	8.83
Testing of the actuator	1,037	1,070	1,089	1,067.67	8.67
Diagnosis of the processor	1,103	1,141	1,160	1,137.83	9.5
Checking, testing and diagnosis of the power pack	1,618	1,671	1,701	1,667.17	13.83
Checking of the CNC console	1,229	1,259	1,282	1,257.83	8.82
Testing of the coolant sensor	2,261	2,341	2,381	2,334.33	20
Mechanical check of the machine	1,977	2,037	2,076	2,033.5	16.5

Table 4
Average/expected time for experiment II (backward pass).

Diagnosed parts	Time "a"	Time "m"	Time "b"	Expected time (s)	Standard deviation
Testing and diagnosis of the processor	1,511	1,563	1,589	1,558.67	13
Checking and testing of the actuator	1,162	1,202	1,223	1,198.83	10.17
Checking, testing, diagnosis and the repair of the power pack	2,799	2,897	2,948	2,889.17	24.83
Checking of the electrical cabinet	2,439	2,520	2,567	2,514.33	21.33
Testing and checking of the spindle motor	1,561	1,613	1,648	1,610.2	14.5
Testing and checking of the table motor	1,273	1,331	1,356	1,325.5	13.83
Diagnosis for the mechanical fault	2,046	2,099	2,145	2,097.83	16.5
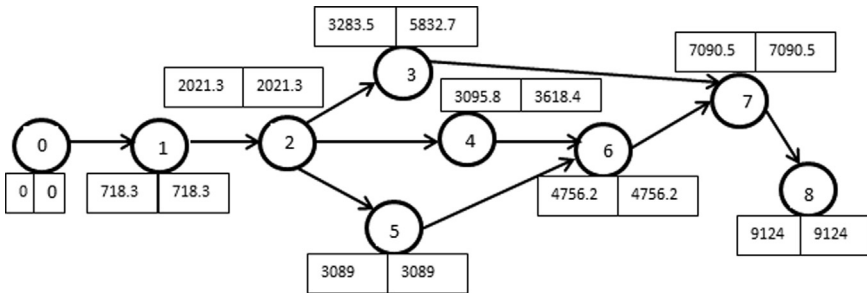
Fig. 8. Network diagram for Experiment I.
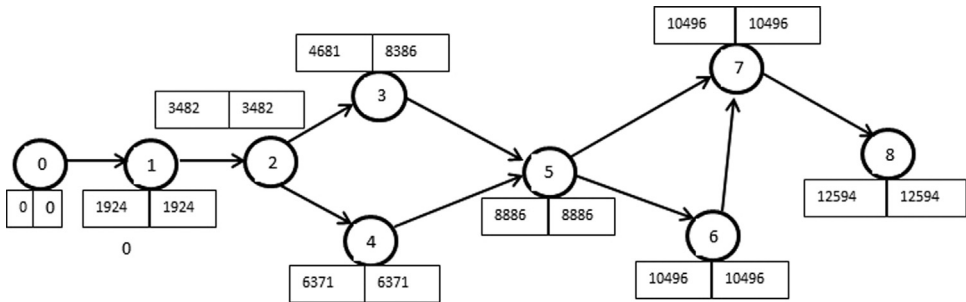
Fig. 9. Network diagram for Experiment II.

Table 5
Analytical table for estimating critical path for Experiment I.

Activity	Duration (s)	Earliest start (ES)	Earliest finish (EF)	Latest start (LS)	Latest finish (LF)	Slack	Standard deviation
0–1	718.33	0	718.3	0	718.3	0	5.7
1–2	1,303	718.3	2,021.3	718.33	2,021.3	0	10.7
2–3	1,262.17	2,021.3	3,283.5	4,570.5	5,832.7	2,549.2	10.2
2–4	1,074.5	2,021.3	3,095.8	2,543.9	3,618.4	522.6	8.8
2–5	1,067.67	2,021.3	3,089	2,021.3	3,089	0	8.7
4–6	1,137.83	3,095.8	4,233.6	3,618.4	4,756.2	522.6	9.5
5–6	1,667.17	3,089	4,756.2	3,089	4,756.2	0	13.8
3–7	1,257.83	3,283.5	4,541.3	5,832.7	7,090.5	2,549.2	8.8
6–7	2,334.33	4,756.2	7,090.5	4,756.2	7,090.5	0	20
7–8	2,033.5	7,090.5	9,124	7,090.5	9,124	0	16.5

Table 6
Analytical table for estimating critical path for Experiment II.

Activity	Duration (s)	Earliest start (ES)	Earliest finish (EF)	Latest start (LS)	Latest finish (LF)	Slack	Standard deviation
0–1	1,923.5	0	1,923.5	0	1,923.5	0	15.83
1–2	1,558.67	1,923.5	3,482.2	1,923.5	3,482.2	0	13
2–3	1,198.83	3,482.2	4,681	7,686.9	8,885.7	4,204.7	10.17
2–4	2,889.17	3,482.2	6,371.4	3,482.2	6,371.4	0	24.83
4–5	2,514.33	6,371.4	8,885.7	6,371.4	8,885.7	0	21.33
3–5 (Dummy)	0	4,681	8,885.7	4681	8,885.7	0	0
5–6	1,610.2	8,885.7	10,495.9	8,885.7	10,495.9	0	14.5
5–7	1,325.5	8,885.7	10,211.2	9,170.4	10,495.9	284.7	13.83
6–7 (Dummy)	0	10,495.9	10,495.9	10,495.9	10,495.9	0	0
7–8	2,097.83	10,495.9	12,593.7	10,495.9	12,593.7	0	16.5

2. Experimental design, materials, and methods

The defective LC-195V5 milling machine is owned by the Federal University of Technology Akure, Nigeria. Two routes or methods of diagnosing tagged Experiment I and Experiment II were used. In Experiment I, the diagnosing was performed from Electrical parts through computer parts to mechanical components. Experiment II on the other hand involves diagnosing from computer components through electrical components to mechanical parts. Diagnostic exercise followed the pre-scribed procedures [2].

Stopwatch was used to record the time taken to diagnose each component part. For reliability of data, three experts were used in diagnosing the parts and time spent by each one for both experiments were recorded as optimistic time "a", pessimistic time "b" and mostly likely time "m".

Average/expected time (T_E) was computed using Eq. (1) and standard deviation (σ) was obtained using Eq. (2)

$$T_E = \frac{a+4m+b}{6} \tag{1}$$

$$\sigma = \frac{(b-a)}{6} \tag{2}$$

Signal generator was used for generating electronic signals (repeating and non-repeating signals); Oscilloscope was used to display and analyse waveform of electronic signals; multimeter was used measure voltage, current and resistance; line tester was used to test phase/live or positive conductor; RCL tester was used to simultaneously detect resistance, capacitance and inductance; while neon tester was for electrical testing.

Acknowledgements

Transparency document. Supporting information

Transparency data associated with this article can be found in the online version at https://doi.org/10.1016/j.dib.2018.10.160.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at https://doi.org/10.1016/j.dib.2018.10.160.

References

[1] O.O. Agboola, B. Kareem, B.O. Akinnuli, Development of a diagnostic schedule for a defective LC-195V5 CNC milling machine using PERT, Leon-. Electron. J. Pr. Technol. 15 (28) (2016) 107–118.
[2] Anilam Operation manual. Three Axis 1100M Programming manual for CNC milling machine, 1997.