APPENDIX J

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The Contributions of Edsel Murphy to the Understanding of the Behavior of Inanimate Objects

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***Abstract*—Consideration is given to the effects of the contributions of Edsel Murphy to the discipline of electronics engineering. His law is stated in both general and special form. Examples are presented to corroborate the author's thesis that the law is universally applicable.**

I. Introduction

IT HAS LONG BEEN the consideration of the author that the contributions of Edsel Murphy, specifically his general and special laws delineating the behavior of inanimate objects, have not been fully appreciated. It is deemed that this is, in large part, due to the inherent simplicity of the law itself.

It is the intent of the author to show, by references drawn from the literature, that the law of Murphy has produced numerous corollaries. It is hoped that by noting these examples, the reader may obtain a greater appreciation of Edsel Murphy, his law, and its ramifications in engineering and science.

As is well known to those versed in the state-of-the-art, Murphy's Law states that "If anything can go wrong, it will." Or, to state it in more exact mathematical form:

$$1 + 1 \;[\text{illegible}]\; 2 \qquad (1)$$

where [illegible] is the mathematical symbol for hardly ever.

Some authorities have held that Murphy's Law was first expounded by H. Cohen[1] when he stated that "If anything can go wrong, it will — during the demonstration." However, Cohen has made it clear that the broader scope of Murphy's general law obviously takes precedence.

To show the all-pervasive nature of Murphy's work, the author offers a small sample of the application of the law in electronics engineering.

II. General Engineering

II.1. A patent application will be preceded by one week by a similar application made by an independent worker.

II.2. The more innocuous a design change appears, the further its influence will extend.

II.3. All warranty and guarantee clauses become void upon payment of invoice.

II.4. The necessity of making a major design change increases as the fabrication of the system approaches completion.

II.5. Firmness of delivery dates is inversely proportional to the tightness of the schedule.

II.6. Dimensions will always be expressed in the least usable term. Velocity, for example, will be expressed in furlongs per fortnight.[2]

II.7. An important Instruction Manual or Operating Manual will have been discarded by the Receiving Department.

II.8. Suggestions made by the Value Analysis group will increase costs and reduce capabilities.

II.9. Original drawings will be mangled by the copying machine.[3]

III. Mathematics

III.1. In any given miscalculation, the fault will never be placed if more than one person is involved.

III.2. Any error that can creep in, will. It will be in the direction that will do the most damage to the calculation.

III.3. All constants are variables.

III.4. In any given computation, the figure that is most obviously correct will be the source of error.

III.5. A decimal will always be misplaced.

III.6. In a complex calculation, one factor from the numerator will always move into the denominator.

IV. Prototyping and Production

IV.1. Any wire cut to length will be too short.

IV.2. Tolerances will accumulate unidirectionally toward maximum difficulty of assembly.

IV.3. Identical units tested under identical conditions will not be identical in the field.

IV.4. The availability of a component is inversely proportional to the need for that component.

IV.5. If a project requires n components, there will be n-1 units in stock.[4]

IV.6. If a particular resistance is needed, that value will not be available. Further, it cannot be developed with any available series or parallel combination.[5]

IV.7. A dropped tool will land where it can do the most damage. (Also known as the law of selective gravitation.)

IV.8. A device selected at random from a group having 99% reliability, will be a member of the 1% group.

IV.9. When one connects a 3-phase line, the phase

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sequence will be wrong.[6]

IV.10. A motor will rotate in the wrong direction.[7]

IV.11. The probability of a dimension being omitted from a plan or drawing is directly proportional to its importance.

IV.12. Interchangeable parts won't.

IV.13. Probability of failure of a component, assembly, subsystem or system is inversely proportional to ease of repair or replacement.

IV.14. If a prototype functions perfectly, subsequent production units will malfunction.

IV.15. Components that must not and cannot be assembled improperly will be.

IV.16. A dc meter will be used on an overly sensitive range and will be wired in backwards.[8]

IV.17. The most delicate component will drop.[9]

IV.18. Graphic recorders will deposit more ink on humans than on paper.[10]

IV.19. If a circuit cannot fail, it will.[11]

IV.20. A fail-safe circuit will destroy others.[12]

IV.21. An instantaneous power-supply crowbar circuit will operate too late.[13]

IV.22. A transistor protected by a fast-acting fuse will protect the fuse by blowing first.[14]

IV.23. A self-starting oscillator won't.

IV.24. A crystal oscillator will oscillate at the wrong frequency — if it oscillates.

IV.25. A pnp transistor will be an npn.[15]

IV.26. A zero-temperature-coefficient capacitor used in a critical circuit will have a TC of –750 ppm/°C.

IV.27. A failure will not appear till a unit has passed Final Inspection.[16]

IV.28. A purchased component or instrument will meet its specs long enough, and only long enough, to pass Incoming Inspection.[17]

IV.29. If an obviously defective component is replaced in an instrument with an intermittent fault, the fault will reappear after the instrument is returned to service.[18]

IV.30. After the last of 16 mounting screws has been removed from an access cover, it will be discovered that the wrong access cover has been removed.[19]

IV.31. After an access cover has been secured by 16 hold-down screws, it will be discovered that the gasket has been omitted.[20]

IV.32. After an instrument has been fully assembled, extra components will be found on the bench.

IV.33. Hermetic seals will leak.

V. Specifying

V.1. Specified environmental conditions will always be exceeded.

V.2. Any safety factor set as a result of practical experience will be exceeded.

V.3. Manufacturers' spec sheets will be incorrect by a factor of 0.5 or 2.0, depending on which multiplier gives the most optimistic value. For salesmen's claims these factors will be 0.1 or 10.0.

V.4. In an instrument or device characterized by a number of plus-or-minus errors, the total error will be the sum of all errors adding in the same direction.

V.5. In any given price estimate, cost of equipment will exceed estimate by a factor of 3.[21]

V.6. In specifications, Murphy's Law supersedes Ohm's.

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[21] P. Dietz, Data Technology, private communication.

*In some cases where no reference is given, the source material was misplaced during preparation of this paper (another example of Murphy's Law). In accordance with the law, these misplaced documents will turn up on the date of publication of this paper.

The man who developed one of the most profound concepts of the twentieth century is practically unknown to most engineers. He is a victim of his own law. Destined for a secure place in the engineering hall of fame, something went wrong.

His real contribution lay not merely in the discovery of the law but more in its universality and in its impact. The law itself, though inherently simple, has formed a foundation on which future generations will build.