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Appraisal of Review of Design in Implementation of Electrical Engineering Projects

O. A. AKINSANYA

Abstract— Engineering designs involve the use of science, technology, intuition and information to achieve transformation of concept into reality in pursuant of specific objectives. An inherent problem is that errors made in the design will affect the quality and performance of any system since reliability of a system is affected at every stage in its production. Data for this study was obtained by direct interview, use of questionnaire and review of samples. This paper showed the importance of review of design at early stages to uncover possible faults, reduce risks of flaws, thereby ensuring that it meets the durability requirement in a safe, functional and cost effective manner. Significantly 94% of examined designs had one or more flaws, while about 33% of designers were unaware of the need for the design review.

Index Terms—: Review; Designs; Strategy; Project; Implementation; Electrical; Engineering.

1 INTRODUCTION

Design, a creative translation of concept into reality, is the application of science, technology and invention to the realization of concept to achieve specific functions with optimum economy and efficiency (Say, 1976). According to Ertas &Jones (1996), the engineering design is defined as a decision making process in which the basic sciences, mathematics, and engineering sciences are applied to convert resources optimally to meet a stated objective. Among the fundamental elements of the design process are the establishment of objectives and criteria, synthesis, analysis, construction, testing and evaluation.

Electrical Engineering designs will cover all designs whose approach, concepts and philosophies hinge on the electrical principles and endeavours, it also involves all manifestation of concepts using electrical technology to achieve specific functions to benefit mankind thereby improving the standard of living. Such designs include that of electrical machines, rural electrification, house-wiring, electronics, telecommunication, control systems, instrumentation, measurements, energy usage and conversion, information technology, wares and fittings among others. Engineering design will reflect the education, perceptions and preferences of the designer, though it entails a balance consideration of previous experience and new ideas, research into material technology, environmental effects and safety, aesthetics, reliability and maintainability, cost analysis and economics, specification and standard codes, performance prediction and optimization e.t.c .

Sydenham (2004) opined that errors committed during design stages would affect the overall performance of any electrical system. This opinion is in close agreement with the view of Billinton (1970) and Wassel (1980) with submissions that malfunctioning of protective relays is largely caused by design errors. In related manner, Akinsanya (2005) opined that power system problems in Nigeria could be traced to improper load forecast design, while Oroge (1991) concluded that design faults are one of the most common causes of early failure in systems.

Review of electrical engineering design is a process whereby the design stages are critically reappraised and examined to uncover possible faults and flaws. Design reviews are a valuable way to elicit information about areas of the design in which there are unresolved technical risks that may need further investigation by way of prototyping, analysis or input from other people experienced in the field. One antidote to the desire for perfection before a design can be scrutinised is to establish a culture where review is a normal part of the engineering process. For the review to be effectively conducted, it is suggested that the reviewers must be experienced engineering personnel independent of the original design. Cunnigham and Cox (1972) concluded that the independent review concept would allow reviewers to discover any inadequacy and will reduce the possibility of omitting design faults due to familiarity with the design. Dieter (1983) and Loveday (1980) shared this view. This paper, therefore presents the importance of electrical engineering design review as strategy for effective project implementation to achieve set functions with anticipated efficiency.

2 METHODOLOGY

In carrying out this work, interviews were conducted to 24 experienced electrical personnel and end users as shown in table 1, while 80 well structured questionnaires were distributed to designers (scholars, private contractors, and government agents), project supervisors (private and government agents) and end users to know their views on the meaning of design, importance of design review, functional grouping of components, stages of design review, independent review concept, awareness and limitations (see table 2).

In addition, a 3-man independent review team was constituted to examine 20 design samples of different authors during stages of design conception, upon completion of system design, and before design implementation. The results are presented in the table 3, 4, 5 and 6 using the percentage approach to form the basis for discussion.

3.0 RESULTS AND DISCUSSION

3.1 Interviews

The importance of design was acknowledged by all groups interviewed, however table 3 showed that 75% agreed that a reviewed design stands a sure chance to effectiveness though at different stages. They also agreed that a properly reviewed design would ease their work and reduce risk of failure, especially if details of findings are documented. 83% of electrical personnel interviewed supported that functional grouping of project components will optimize project execution, supervision and material usage. 67% of designers accepted the concept of independent review team to curb flaws due to familiarity with the design. The end users were mostly interested in the efficient operation of a system, about 80% opined that such exercise would have a life cycle cost benefit.

3.2 The Design Conception Stage

This is probably the most important as it determines the approaches, concepts and philosophies that are used in developing the design. The basic idea is taken and strategy for meeting the requirement is developed with various studies on alternative options, support strategies, components/raw material alternatives etc.

One or more flaws were discovered in 90% of the samples while only 10% were without flaws. At this stage, only 62.5% of designers saw the importance of the review exercise, 25% did not agree while 12.5% were indifferent. The results here influenced the determination of reliability target, material alternatives, design concept and operational parameters that are useful in developing the framework within which detailed design can be built. The reviewers submitted that

(i) Appropriate technology should be used.
(ii) Reliability goal should be defined and be realistic.
(iii) Components should be grouped functionally and where possible they should be in modules.
(iv) Reasons and supporting data for the studies should be evaluated to ensure validity of target.

Items (i) to (iv) to large extents, agreed with the view of Cluley (1974), Hurst (1999) and Pahl (2007)

3.3 Review of System Design

System design at this stage is of more concrete form as system layouts with specification have been determined and the framework is established within which the design can efficiently start. Table 5 gives 70% of examined work, as having one or more flaws while 30% had no flaws. Also in table 6, awareness of the need for the review exercise attains 75% while only 10% were indifferent. The reviewers submitted that:

(i) Emphasis was placed on detailed drawings, testing and evaluation, configuration and documentation to support reliability anticipation.
(ii) The concept of functional grouping should be prevalent.
(iii) Cost benefit derivable from design improvement can be determined, as it will reduce production cost.
(iv) Components, equipment layout, necessary product support should be standard and be available.

3.4 Critical Design Review

The critical review was done after the final production drawings have been completed. In this study, one or more flaws were discovered only in 20% of the examined designs. Also the awareness for the need for the design review before implementation appreciated to 85%. The critical design review essentially broadened the scope of the review to determine if final design best meet the operational, maintenance and product support requirements and this again is in agreement with the views expressed by Oroge (1991) and Simpson (1976). The reviewers submitted that:

(i) Comprehensive analysis of design and associated requirements must be met.
(ii) Supporting materials should ensure cost effectiveness.
(iii) Stated reliability and performance estimates must be accommodated by the design since this is importantly the last opportunity before commitment.

Analyzing the above discussions, it is clear that the review exercise eliminates the risk of flaws, uncovers possible faults, and reawakens the awareness of designers of the great importance of design review.

4 CONCLUSION

This study has shown the great importance of design reviews. The conceptual design review examined the basic concepts and philosophies to be used in the design. The system design narrowed the scope to examine the design within the context reached at the end of the conceptual phase.

Formal design review provides the opportunity for an independent and objective look at critical considerations during the design process. These reviews introduce new perceptions and viewpoints to the process and encourage more self-review on the part of a designer.

A formal meeting of the designer and reviewers will enhance the interchange of ideas and therefore assists in effective coordination of diverse ideas. A well-scheduled review that employs technically competent, independent scholars will greatly reduce the risk of design flaws in the system as it enters implementation stage hence a reduction in the life cycle cost.

5 REFERENCES

Akinsanya, O. A. "Electrical Power System in Ekiti State-Problems and Suggestion" Educational and School Review 2(1) pp102-106, 2005.

Billinton, R. "Power System Reliability Evaluation" Gordon and Breach Publishers, U.S.A., 1970.

Cluley, J. C. "Electronic Equipment Reliability", Macmillan Press, London, 1981.

Cunnigham, C. E. and Cox, W. "Applied Maintainability Engineering" J. Wiley & Sons Publishers, New York, 1972.

Dieter, G. E. "Engineering Design-A Materials and Processing Approach" McGraw-Hill Publishing co. London, 1983.

Ertas, A. & Jones, J. "The Engineering Design Process" 2nd ed. John Wiley & Sons, Inc. New York, 1996.

Hurst, K.S "Engineering Design Principles" Elsevier ltd, Linacre House, Jordan Hill. John Wiley & Sons Inc., Third Avenue, New York, 1999.

Loveday, G. C. "Electronics Testing and Fault Diagnosis" Pitman Publishers, London, 1980.

Oroge, C. O. "Fundamentals of Reliability and Testing Methods" SOOJI Press Ltd. Kaduna, Nigeria, 1991.

Pahl, G. "Engineering Design- a Systematic Approach" 3rd Edition Springer Publishing co. UK, 2007

Say, M. G. "Alternating Current Machines" 4th Edition Pitman Publishing Co, New York, 1976.

Simpson, A. "Testing Methods and Reliability". Macmillan Publishers, London, 1976.

TABLE 1

Designers (12)	Project supervisors (6)	Clients (6)
Students	Lecturers	Private owners
Private groups	Contractors	Government
Govt. agents	Govt. agents	

Govt. = Government

TABLE 2
UNITS FOR MAGENTIC PROPERTIES

Category		Number
Designers	Scholars	10
	Private groups	10
	Government agents	10
Project supervisors	Private groups	12
	Government agents	08
End users		30

Sydenham, A,H " System Approach to Engineering Design" Artech House Publishers, USA, ISBN 1580534791, 2004.

- *Akinsanya olusola Ayodeji is a lecturer at the Federal Polytechnic, Ado Ekiti Nigeria and he is currently pursuing a Ph.D degree program in electric power engineering at the Ambrose Alli University, Ekpoma Nigeria. E-mail:olusolaakinsanya@mail.com*

Wassel, H. J. H. "Reliability of Engineering Products, Engineering Design guides", Oxford University Press, London, 1980.

TABLE 3
RESPONSES FROM INTERVIEW

Subject	NR	P	N
Meaning of design	24	24	--
Importance of design review	24	18	06
Independent design review concept	24	16	08
Functional grouping concept	24	20	04

NR= Number of Responses, P= Positive Response, N= Negative Response.

TABLE 4
RESPONSES FROM QUESTIONNAIRES

Subject	NR	P	N
Meaning of design	80	80	-
Importance of design review	72	52	20
Independent design review concept	46	35	11
Functional grouping concept	36	29	7

NR= Number of Responses, P= Positive Response, N= Negative Response.

TABLE 5
REVIEW OF ELECTRICAL DESIGNS

Stages	NDS	NF	NWF
1	20	18	2
2	20	14	6
3	20	4	16

NDS= Number of Design Studied, NF= Number with Flaws, NWF= Number without Flaw.

TABLE 6
AWARENESS OF NEED FOR DESIGN REVIEW

Stages	NR	Fav.	Unfav.	Ind.
1	40	25	10	5
2	40	30	6	4
3	40	34	4	2

NR= Number of Responses, Fav.= Favourable, Unfav.= Unfavourable, Ind.= Indifferent.

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