

On Commercially Relevant Research In Indian EE R&D Ecosystem

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Abstract : Commercially relevant research in Electrical and Electronics (EE) Research and Development (R&D) ecosystem has become essential to boost India's EE manufacturing. In India, EE product sell is regulated under Electronics and Information Technology Goods (Compulsory Registration) Order (CRO), which allows only products compliant to the specified standards. This along with Indian environmental laws like E-waste (Management) Rules 2016 provides restrictions on sellable products. The Indian EE R&D ecosystem needs to develop EE products that are compliant to the Indian standards and regulations. There is lack of knowledge of standards and regulations among researcher communities and lack of methodology for adoption of standards during R&D phase. This paper describes the need for adoption of standards & a methodology for adoption of standards during R&D phase through modified Nair's Product Development Cycle by EE researchers. Subsequently, a case study will be presented for electrical energy storage devices (Li-ion batteries & supercapacitors). The study reveals relevant Indian standards for Li-ion battery exist but there is lack of relevant Indian standards for supercapacitors. Solution to such cases for researchers is to follow relevant International Electrotechnical Commission (IEC) standards.

Keywords : CRO, R&D, standards, batteries, supercapacitor, IEC standards, BIS standards

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I. Introduction

Sustainable development is key to success in globally competitive scenario. Sustainable development when defined as social development which fulfills the needs of present generation without endangering the possibilities of fulfillment of the needs of future generation [1] dictates that any technology is sustainable when it is economically viable, socially acceptable and ecologically sustainable for long run [2]. To ensure this view, products must meet technical standards of various kinds and should be complaint to all related rules, regulations and guidelines. Major advantages of standards are listed below:

- a. Technical standards constitute non-tariff barriers for market economy which protects local economy from global market pressures during high demand scenarios. For example, Digital India Program of Government of India have put increased demand on electronics goods which have lead to invasion of sub-standard goods from competing economies. Under this situation local manufacturers can benefit from compliance to standards.
- b. Compliance to standards makes local manufacturing globally competitive and export potential of the country goes up.
- c. Standards improve consumer safety during utilization of product and curb inflow of unsafe products from outside the country.

In India, electronic goods are regulated under Electronics and Information Technology Goods (Compulsory Registration) Order (CRO), which allows only electronic products compliant to the specified standards [3,4,5]. As per the order, no person is allowed to manufacture or store for sale, import, sell or distribute electronic goods which do not conform to the specified Indian Standards mentioned in the order. Manufacturers of these products are required to apply for registration from Bureau of Indian Standards (BIS) after getting their product tested from BIS recognized labs. Since its inception, the order is being applied to increasing product categories of Electronic Goods. In addition to above mentioned Indian standards, India's environmental laws also provide restrictions on EE products as per E-waste (Management) Rules 2016. The rule manages the waste stream and provides restrictions of usage of specified materials in the EE products which could cause environmental pollution during any stage of EE product life (research, manufacturing, during use, refurbishing, e-waste dump and e-waste recycling). In this paper we would focus on standards only and environmental aspects has been dealt earlier in detail, which is published elsewhere [6].

Currently, India’s standard product space share in Indian Market is only 25.82%, as per CRO listings [7], which need to be increased above international rate to keep Indian EE companies competitive in Indian market. To succeed in producing new products in EE commercial space an intense time line and regulatory compliance is required to be followed as the pace of innovation; pace of new product launch and rate of obsolescence of technology are exceptionally high in this sector. This pace is expected to increase many times with the advent of Artificial Intelligence (AI) and its adoption in EE ecosystem (product design, material design, commerce etc.) The pace is expected to break the international patent based economics of EE ecosystem. Artificial Intelligence and its effect on EE ecosystem will be dealt elsewhere in future. Current Indian EE R&D ecosystem is lacking behind in producing new products as compared to international rate which is due to several reasons. Although EE R&D ecosystem is very active in India, it is only good at producing manpower such as design space engineers for services while lacking behind in translation of R&D to sellable product for manufacturing. One of the major reasons for this academia and industry gap is lack of knowledge of standards among EE researchers and adoption of it during R&D phase.

In this paper, BIS standards for electronics and information technology goods have been introduced through Compulsory Registration Order as issued by Ministry of Electronics and Information Technology (MeitY), Govt. of India. This is followed by description of how EE researchers can adopt BIS standards during R&D phase of product development through modified Nair’s Product Development Cycle. Such adoption is expected to increase the conversion rate of research to product. A case study has been presented in section 3 for Li-ion battery and supercapacitors. The study reveals that BIS standards for Li-ion cell exist while researchers still have to rely on IEC standards for supercapacitors.

II. Compulsory Registration Order (Cro)

"Electronics and Information Technology Goods (Requirement for Compulsory Registration) Order" was first notified by MeitY or erstwhile Department of Electronics and Information Technology (DeitY) on 3 Oct 2012 [3]. Subsequently the order has been amended several times and current order is “Electronics and Information Technology Goods (Requirement for Compulsory Registration) Order 2016”. The order states that no person shall by himself or through any person on his behalf manufacture or store for sale, import, sell or distribute electronics and information technology goods which do not conform to the Indian Standard specified in the order. The order is applicable to goods specified in the column (2) of the Schedule annexed with the order. Since 2012, schedule has been progressively applied to increasing product categories of electronic goods and the current schedule contains 44 products. These along with corresponding standards are listed in Table I. The details of standards are listed in Table II.

Table I. Products covered by Compulsory Registration Scheme (as on February 2018)[3,4,5].

No.	Product Category	Indian Standard
1	ELECTRONIC GAMES (VIDEO)	IS 616:2010
2	LAPTOP/NOTEBOOK/TABLET	IS 13252(Part 1):2010
3	PLASMA/LCD/LED TELEVISIONS OF SCREEN SIZE 32"; AND ABOVE	IS 616:2010
4	OPTICAL DISC PLAYERS WITH BUILT IN AMPLIFIERS OF INPUT POWER 200W AND ABOVE	IS 616:2010
5	MICROWAVE OVENS	IS 302-2-25:2014
6	VISUAL DISPLAY UNITS, VIDEO MONITORS OF SCREEN SIZE UP TO 32 & ABOVE	IS 13252 : 2010
7	PRINTERS, PLOTTERS	IS 13252(Part 1):2010
8	SCANNERS	IS 13252(Part 1):2010
9	WIRELESS KEYBOARDS	IS 13252(Part 1):2010
10	TELEPHONE ANSWERING MACHINES	IS 13252(Part 1):2010
11	AMPLIFIERS WITH INPUT POWER 2000W AND ABOVE	IS 616:2010
12	ELECTRONIC MUSICAL SYSTEMS WITH INPUT POWER 200W AND ABOVE	IS 616:2010
13	ELECTRONIC CLOCKS WITH MAINS POWER	IS 302-2-26:2014
14	SET TOP BOX	IS 13252(Part 1):2010
15	AUTOMATIC DATA PROCESSING MACHINE	IS 13252(Part 1):2010
16	POWER ADAPTORS FOR IT EQUIPMENTS	IS 13252(Part 1):2010
17	POWER ADAPTORS FOR AUDIO,VIDEO & SIMILAR ELECTRONIC APPARATUS	IS 616:2010
18	UPS/INVERTORS OF RATING <= 5KVA	IS 16242(Part 1):2014
19	DC OR AC SUPPLIED ELECTRONIC CONTROLGEAR FOR LED MODULES	IS 15885(Part 2/Sec 13):2012
20	SEALED SECONDARY CELLS/BATTERIES CONTAINING ALKALINE OR OTHER NON-ACID ELECTROLYTES FOR USE IN PORTABLE APPLICATIONS	IS 16046:2015

21	SELF-BALLASTED LED LAMPS FOR GENERAL LIGHTING SERVICES	IS 16102(Part 1):2012
22	FIXED GENERAL PURPOSE LED LUMINAIRES	IS 10322(Part 5/Sec 1):2012
23	MOBILE PHONES	IS 13252(Part 1):2010
24	CASH REGISTERS	IS 13252(Part 1):2010
25	POINT OF SALE TERMINALS	IS 13252(Part 1):2010
26	COPYING MACHINES/DUPLICATORS	IS 13252(Part 1):2010
27	SMART CARD READER	IS 13252(Part 1):2010
28	MAIL PROCESSING MACHINES/POSTAGE MACHINES/FRANKING MACHINES	IS 13252(Part 1):2010
29	PASSPORT READER	IS 13252(Part 1):2010
30	POWER BANKS FOR USE IN PORTABLE APPLICATIONS	IS 13252(Part 1):2010
31	INDIAN LANGUAGE SUPPORT FOR MOBILE PHONE HANDSETS	IS 16333 (Part 3) : 2016
32	RECESSED LED LUMINARIES	IS 10322 (Part 5/Section 2) : 2012
33	LED LUMINARIES FOR ROAD AND STREET LIGHTING	IS 10322 (Part 5/Section 3) : 2012
34	LED FLOOD LIGHTS	IS 10322 (Part 5/Section 5) : 2013
35	LED HAND LAMPS	IS 10322 (Part 5/Section 6) : 2013
36	LED LIGHTING CHAINS	IS 10322 (Part 5/Section 7) : 2013
37	LED LUMINARIES FOR EMERGENCY LIGHTING	IS 10322 (Part 5/Section 8) : 2013
38	UPS/INVERTERS OF RATING <= 10KVA	IS 16242 (Part 1) : 2014
39	PLASMA/ LCD/LED TELEVISION OF SCREEN SIZE UP-TO 32	IS 616 : 2010
40	VISUAL DISPLAY UNITS, VIDEOS MONITORS OF SCREEN SIZE 32" AND ABOVE	IS 13252(Part 1):2010
41	CCTV CAMERAS/CCTV RECORDERS	IS 13252 (Part 1) : 2010
42	ADAPTERS FOR HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES	IS 302 (Part 1) : 2008
43	USB DRIVEN BARCODE READERS, BARCODE SCANNERS, IRIS SCANNERS, OPTICAL FINGERPRINT SCANNERS	IS 13252 (Part 1) : 2010
44	SMART WATCHES	IS 13252 (Part 1) : 2010

Manufacturers of these products are required to apply for registration from Bureau of Indian Standards (BIS) after getting their product tested from BIS recognized labs. List of BIS recognized labs are provided in BIS website [8], which is updated from time to time. BIS then registers the manufacturers under its registration scheme who are permitted to declare that their articles conform to the Indian Standard(s). The registered manufacturers are allowed to use the Standard Mark notified by the BIS (Fig. 1). The registration is initially granted for two years which has to be renewed after every two years. Failing to conform to the standards during laboratory testing requires manufacturers to deform their product beyond use and dispose off the deformed product as scrap. The scheme applies to repaired/ refurbished/ second hand items as well and such products need to register with the scheme or get exemption letter from MeitY. Unregistered repaired/ refurbished/ second hand items are not allowed to be imported without prior permission from MeitY. Detailed discussion on each product standards, date of implementation and amendments in rules are beyond the scope of this paper and researchers are encouraged to consult MeitY's website [9] for current rules.

Table II. Indian Standards relevant to Compulsory Registration Scheme [3,4,5]

No.	Indian Standard number	Description
1	IS 616:2010	Audio, Video and Similar Electronic Apparatus - Safety Requirements
2	IS 13252:2010	Information Technology Equipment-Safety (General Requirements)
3	IS 302 (Part 1) : 2008	Safety of household and similar electrical appliances-Part-1:General requirements
4	IS 302-2-25:2014	Safety of household and similar electrical appliances-Part-1: Particular Requirements: Microwave Oven
5	IS 302-2-26:2014	Safety of Household and Similar Electrical Appliances Part-2: Particular Requirements : Clocks
6	IS 16242(Part 1):2014	Uninterruptible Power Systems (UPS) Part 1 General and Safety Requirements for UPS
7	IS 15885(Part 2/Sec 13):2012	Safety of Lamp Control gear Part 2 Particular Requirements Section 13 DC Supplied Electronic Control gear for LED Modules

8	IS 16046:2015	Secondary Cells and batteries containing alkaline or other non-acid electrolytes-safety req. for portable sealed secondary cells, and for batteries made from them, for use in portable applications
9	IS 16102(Part 1):2012	Self-Ballasted LED Lamps for General Lighting Services Part -1 Safety Requirements
10	IS 13252(Part 1):2010	Information Technology Equipment-Safety (General Requirements)
11	IS 10322(Part 5/Sec 1):2012	FIXED GENERALPURPOSE LUMINIARES: -Luminaries Part 5 Particular Requirements Section 2 Recessed Luminaries
12	IS 10322 (Part 5/Section 2) : 2012	FIXED GENERALPURPOSE LUMINIARES: -Luminaries Part 5 Particular Requirements Section 2 Recessed Luminaries
13	IS 10322 (Part 5/Section 3) : 2012	FIXED GENERALPURPOSE LUMINIARES :-Luminaries - Part 5: Particular Requirements - Section 3: Luminaries for Road and Street Lighting
14	IS 10322 (Part 5/Section 5) : 2013	FIXED GENERALPURPOSE LUMINIARES :-Luminaries - Part 5: Particular Requirements - Section 5: FLOOD LIGHTS
15	IS 10322 (Part 5/Section 6) : 2013	FIXED GENERALPURPOSE LUMINIARES :-Luminaries Part 5 Particular requirements Section 6 Hand lamps
16	IS 10322 (Part 5/Section 7) : 2013	FIXED GENERALPURPOSE LUMINIARES :- Luminaries Part 5 Particular requirements Section 7 Lighting chains
17	IS 10322 (Part 5/Section 8) : 2013	FIXED GENERALPURPOSE LUMINIARES :- Luminaries Part 5 Particular requirements Section 8 Luminaries for emergency lighting
18	IS 16333 (Part 3) : 2016	Indian Language support for Mobile phone handsets

III. CRO And R&D

For R&D, Table I and Table II which describes the standards related to product type are important. Conventional R&D methodology for product development involves compliance testing after pilot production. Although compliance testing at this stage is necessary, one should additionally bring the compliance testing during proof of concept, design and prototyping stages or in other-words during R&D stage as per modified Nair’s Product Development Cycle to improve the confidence of industry during pre-competitive R&D [6]. The modified Nair Cycle is described in Fig 2. Bringing the compliance testing earlier can potentially attract industrial partners during R&D stage and increase the rate of transfer of technology after R&D stage.

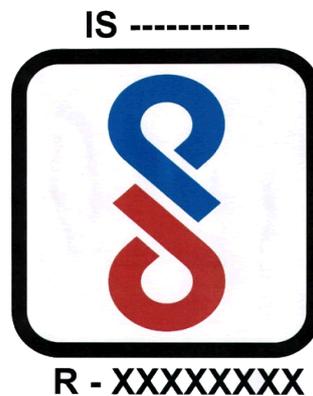


Fig. 1 Standard Mark for Compulsory Registration Scheme, Bureau of Indian Standards

IV. Case Study For Electrical Energy Storage

Electrical energy storage devices stores electrons and release them when required. In this paper, case studies for electrical energy storage technologies of secondary Li-ion batteries and double layer supercapacitors are presented to clarify how compliance testing should be under taken at R&D stage for such product categories. As per Table I, item 30 provides the standard requirements for “SEALED SECONDARY CELLS/BATTERIES CONTAINING ALKALINE OR OTHER NON-ACID ELECTROLYTES FOR USE IN PORTABLE APPLICATIONS”. IS 16046:2015 is the BIS standard for this category which includes testing methodology for Nickel and Lithium based systems and safety requirements. This standard is related to international standard of IEC 62133: ‘Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications’. Thus for a Li-ion cell the product category matches with item 30 of Table I. This standard specifies insulation and wiring standards, charging methodology, molded case stress standards at high ambient temperature, external short-circuit testing methodology, free fall standards, thermal abuse standards, crush testing standards, over-charging standards, and forced short-circuit testing methodology for Li-ion cells. If

however, the application is a power bank using Li-ion batteries particularly for portable applications, the item 30 will also be invoked. In such case the product needs to satisfy additional standard of IS 13252(Part 1):2010 which is “INFORMATION TECHNOLOGY EQUIPMENT-SAFETY (GENERAL REQUIREMENTS)”. International equivalent of this standard is IEC 60950-1. Thus any one carrying out R&D on Li-ion cell should ensure compliance to IS 16046:2015 while any researcher carrying out R&D on Li-ion power bank only should ensure compliance to IS 13252(Part 1):2010 assuming BIS standard Li-ion cells will be utilized in the power bank. This standard specifies the general principles of safety and hazards, standards for materials and components, protection from hazards, wiring, connection & supply standards, physical requirements (stability, mechanical strength, design and construction, thermal requirements, opening in enclosures, and resistance to fire), electrical requirements and simulated abnormal conditions (touch current and protective conductor current, electric strength, abnormal operating and fault conditions), standards for connecting to telecommunication networks and to cable distribution systems. Full details of standards are out of the scope of this paper and reader is encouraged to read and understand the latest published standards as standards are amended from time to time.

Electronics and Information Technology Goods (Requirement for Compulsory Registration) Order product schedule currently do not include supercapacitor (double layer capacitors). Under such case researcher is advised to follow IEC standards as most BIS standards are identical adoption of IEC standards or adoption with minor changes which provide seamless global applicability. Thus until Compulsory Registration Order notifies standards for supercapacitors, IEC 62576: ‘Electric double-layer capacitors for use in hybrid electric vehicles - Test methods for electrical characteristics’ could be used for double layer supercapacitors. The standard provides electrical characteristics of electric double-layer capacitor cells to be used for peak power assistance in hybrid electric vehicles (EVs) only; it is the only standard available for double-layer supercapacitor.

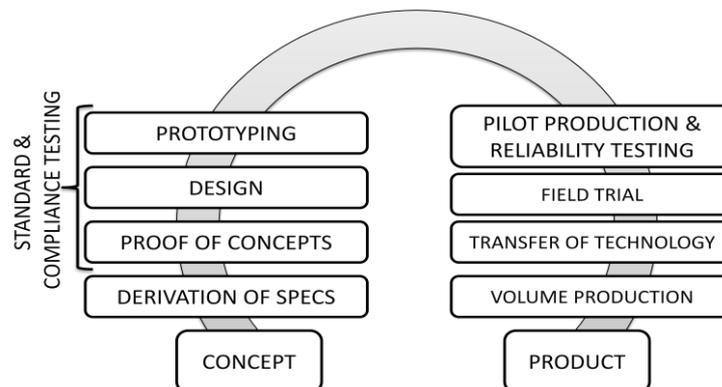


Fig. 2 Modified Nair’s Product Development Cycle [8].

V. Conclusion

A discussion on the requirement of introduction of standards testing in EE R&D phase was presented in the paper. The requirement arises from the lower transitional rate of R&D to sellable product for manufacturing. Such lower rate is rendering Indian EE industry uncompetitive with international companies. A detailed discussion on Indian EE standards was carried out and along with how such standards can be adopted by EE researchers. A case study was then presented on how Li-ion battery and supercapacitor standards can be adopted by researchers. From the study it was shown that if Indian standards are lacking in any area of EE, researchers can adopt the IEC international standards for their work.

VI. Disclaimer

Views presented in this paper pertain to author only and does not represent Government of India’s views on the matter.

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