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Intelligent Automation, Planning & Implementation: A Review of Constraints

Sushant Kumar Vishnoi[1], Anuj Tripathi[1] and Teena Bagga[2]
Research Scholar, Amity Business School, Noida Amity UniversityUttar Pradesh, India.
Professor, Amity Business School, Noida Amity University Uttar Pradesh,India.

(Corresponding author: Dr. Teena Bagga)
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ABSTRACT: In this era of intelligent technologies and smart computing systems, organizations are customizing their operations and processes to align them with trending technological innovations. Complementing highly flexible, competitive and globalized business environment, automating business processes and systems can be a route to successful business operations. In addition to bestowing advantage of core-competence and competitive excellence to businesses, automation suffers from constraints such as huge money investments, absence of collaborative models, implementing mechanism, men-machine interaction & integration and absence of measurement machinery. This paper proposes an automation-environment relationship grid and summarizes constraints in automation planning, adoption and successful implementation by corporations through extensive review of available literature.

Keywords: Automation Constraints, Automation Planning Challenges, Automation Implementation Challenges, Human-Machine interaction, Intelligent Automation, Men-Machine Interaction.

I. INTRODUCTION

Introduction, implementation and institutionalization of machines and technology aided systems i.e. computer resource to aid or replace human resource is defined as automation. It can take the form of man-machine interface or work alignment. In real time observed cases where the machine or computer systems plays the central role of managing the operation it is referred to as machine-centric automation else where the human resource plays the proactive task of handling key functions it's the essence of human-centric automation. Generally, a mix of above stated machine-men interaction is often earmarked as the best combination for enhanced system performance. Given the invention or innovation trends in computer system speeds, storage, intelligence computer systems are better aligned to perform even the cognitive tasks of planning and decision making [1]. In this era of highly flexible, competitive and globalized business environment, automating business processes and systems en-route to successful business operations. Automation can take the form of adaptive or flexible automation i.e. enabling real time modifications of systems under operation either by men or by machine [2-4] to traditional operator-centric characterized by static systems features. Once the cornerstone of high-end organization automation systems now a days are considered as the milestones by modern enterprises serving the necessary requirement of. Be it healthcare, defense, aviation, manufacturing, automobile, trading information systems, automated systems seem omnipresent and omnipotent while differing only in intensity and percentage of implementation. In addition to legal and ethical concerns of automation [5], its emergence and growth is so intense that low cost, mass produced industrial robots were projected to take over the reins of employment podium over the coming decade [6]. In fact, more potentially autonomous the machine resource is; equally low is their social acceptance [7]. Equally important is the consideration for Automation life cycle planning bringing forth the intricacies of timely upgradations, modifications and replacements. While automating processes, functions and operations bestows the organizations with competitive advantage over rival organizations which over time, learning-experience and expertise transforms to core competence. Additionally, automated process results in savings of time and better alignment of bottom lines to profits in cost-benefit computations. The area of automation concern is the smooth incorporation of technology into area of work design, organization and management. Often lags are noticed between workplace design and workplace automation as they fail to accommodate technological advancement with workforce requirements. Involvement of workforce into planning, conception and implementation of automation can aid better workplace design and accommodate healthy men-machine interface. Coevolution of men and machines is the sparkling solution as intelligent machines often are not enough to initiate and implement automation mechanism, but human skills and intelligence needs to be refurbished in lieu of machine capabilities to stay competent and smooth transformation.

A. Automation and the changing dynamics of human roles and operations:

Depending upon the environment organizations are operating on and level of automation organizations are seeking to undergo, thrust upon are changing requirements of human resource roles. Where the organization environment is static and level of automation is low; operators are required to perform the ancillary, assistive or reactive function otherwise in dynamic environment characterized by high degree of automation human operations need to be at vigil and furnish their role to their proactive or supportive functions [8] i.e. performing to monitoring. In lieu of same automation marks a shift change in operator working modes from active controllers to advisory or supervisory to ancillary depending upon the degree of automation and environments they are operating on.

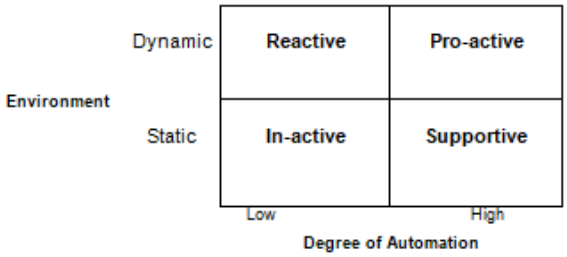

Fig. 1. Automation Environment Relationship Grid.

II. LITERATURE REVIEW

A. Literature Review and concept development

Automation imperative seems to have the newest bug biting blessed of the minds of biggest of the business circles and board rooms of organizations. Automation is often discussed around the interlinked niches of men-machine interaction. Human satisfaction, security, safety and job performance and associated research suggest that though automation relieves people of tasks, but more attention is required on operator training, men-machine interaction and physical interface design which in turn decide the turnaround and transformation of men-machine coevolution [9]. Another way around towards corporate performance management can be adjudged as the integration of business process automation, business intelligence, analytics [10]. Additionally, the successful acceptance and application of intelligence systems in an organization to a great extent depends upon a fusion of individual factors, social and situational factors [11]. The widely speculated hazards of automation , AI and robotics changing the employment landscape of the world including the heterodetic of tasks within operation are not substantial [12], impacting only 9% of jobs in OECD economies, 6% in Korea and 12% in Austria [13] as opposed to claims of automation universally eating into 55% of jobs as next generation employment killer [14]. Organizations having low level of technology infusion into its operations and low familiarity with information technology are researched to have high adverse impact on workplace workforce automation else the organizations having high level of technology familiarity are proved to have minimum effect on workforce and workplace automation. Since the systems to be monitored continued to increase in complexity and computational ability, an increases trends towards challenges and catastrophic failures of automation implementation are often accompanied by automation incorporation [15,16].

III. CONSTRAINTS IN AUTOMATION PLANNING & IMPLEMENTATION

An extensive analysis of literature of the subject in consideration i.e. automation bring forth a host of constrains and critical missing factors of successful planning, conceptualization, implementation and management. (Refer Appendix A).

A. Model Constraint

Automation being in the early stage of design and development; designer-operator divergence in implementation [17], lack of time-tested and applicable models which forms the core of architecture of computational networks and hardware components is one critical component thoroughly missed for automation planning. Absence of universally accepted and benchmarked model fitting to a host of different organizations varying along dimensions of IT enabled applications and operations capabilities [18]. Unstructured administrative machinery, non-existent government reforms, initiatives and research is poised to have shaped the automation constraints upwards. Furthermore, the models accepted across one sector need to be refurbished and customized in sync with types, stages and levels of automation i.e. incorporating accepted manuals of respective sectors [19].

B. Money Constraint

Money costs of automation referred to as combination of hardware costs, software costs and human-resource costs. Paucity of funds for automation or huge investment costs for institutionalization, maintenance, human resource training, expert collaboration, specialized teams for managing routine tasks and operations, computational (hardware) infrastructure and software testing serves as the key money costs of planning automation [20,21]. Finally, different sizes of organization, cultures, human resource intellectual capabilities, IT integration, area of operations or sectors requires customization of hardware and software components, adding more weightage to expenses charts of automation [22]. Overall the different costs associated with automation testing makes the financials of automation too complex to understand and implement [23].

C. Management constraint

Lack of management initiative to bring forth this milestone change and to be involved in the process from conception to implementation of automation [24]. Furthermore, management resistance and openness to change in tune with the dynamic business environment and competitive scenarios is the missing link [25]. Ill-stated trust in automated technologies, machine managed operations bring forth by political, legal, ethical and social constraints [26], privacy and security concerns, long standing problems of men-machine work synchrony and finally ever occurring machine-errors are some of the management-oriented constraints of automation implementation [27]. As automation system architects, the developer bias got automatically induced in the system development and performance [28].

D. Men-Machine interaction constraint

Ability required from human resource to own and manage automated platforms and tasks seems unprecedented area of concern. From managing machines in lead roles to be working on them as assistants or supervisory roles requires operators to re-skill them in selected areas [29,30]. The susceptibility of human operators to adopt learn-unlearn-relearn paradigm through extensive training programs can reduce automation complexity and improve operator performance [31], seems difficult and non-existent.Additionally, men-machine interaction is often cited as the biggest constraint expediting system failures in automation because of complex system interactions not anticipated by developers [32,33]. Another constraint of men-machine interaction is the problem of coordination in times of system errors and failures [34]. Whether accountability is men-marked or machine-marked is also an area of concern.

E. Measurement Constraint

Measurement constraint of automation is the absence of tools and techniques for recording the impact automated process, functions and operations are having on

organizational people and profits. Several studies analyzed the costs attributed to automation stakeholders in the form of automation machinery, workforce reskilling and training, software upgradations, and the contribution or profits each one of these change agents making to organizations are found to be non-significant [35]. Lack of impact measurement tools against the initiated automation process is by far the missing link between automation conception to institutionalization and post-implementation [36].

F. Mechanism Constraint

Mechanism constraint of automation directs us towards the non-availability of literature on who, when, where, why, and how to go after the process of automation and what procedures needs to be followed for successful implementation or maintenance which seems simply non-existent or non-verifiable [37]. Lack of information sharing seminars, workshops, conferences on dedicated theme of automation is also making the things worst for business fraternity eyeing the know-how of automation planning and implementation. Automation projects are highly complex and are planned and managed across technical, operational, clinical, human and financial dimensions [38]. More worrisome is the absence of supporting government reforms and collaborative machinery from the platform of dedicated automation stakeholders. The mechanism to successfully test-implement automation is over-raided by corporations' strategies of centralizing their technology resources for their operational efficiency only and not generalizing them for broader benefit and impact.

IV. CONCLUSION

Once considered as a competitive advantage, automation implementation now a days is viewed as more of a necessity rather than a core-competence. Organizational processes, systems and programs once fully automated serves the purpose of interlinking and aligning organizational objectives with external and internal economic and business environment. Automating enterprises in lieu with organizational and resource-holder requirements of sharing information and communication can be served fruitfully and successfully. Automating key process in sync with industry standards not only serves the purpose of decentralized functions and individual roles but also results in savings of time resource, money resource and human resource. Usually a phenomenon employed by western corporations in sync with their technological supremacy, automation still is not fully incorporated into mainstream operation by third world countries except recently initiated reforms of IOT enabled smart cities [39] and smart campuses [40]. The expertise and specialization surmounting the installation and maintenance of automation systems comes at a huge cost requiring initiative and involvement by key positions (CEO/CFO) and their willingness to communicate and convince the organization stakeholders (employees, suppliers, customers) whole-heartedly about the boards vision before actualizing the implementation process. The proposed constraints in the form of "requirement of huge money resource, management trust in automation technological benefits, willingness to adopt or invent working models, calculating all possible men-machine interactions or workplace dispositions, institutionalizing measurement techniques of weighing automation benefits and installing mechanism of successful operations post automation implementation" must be aligned significant weightages and remedial measures must be looked at and incorporated. These constraints can be minimized or removed by incorporating the supporting machinery processes in the form of Public-private-academia partnerships for researching feasible models, business function delineation by making technology the new core of business functions, reposing management faith in automation systems, by integration of man-machine work divide, through work force reskilling, and training making them competent and machine experts, devising and suing various statistical tools for measuring possible costs and benefits of automation in management profits and finally by putting into place well sculpted automation governance and management laws.

Appendix A

Constraints by various Reseacrhers

Constraints	Missing Factors	Author
Model Constraint	Absence of Universally accepted and benchmarked models. Designer-operator divergence viewpoints in planning and implementation. Lack of accepted models across sectors in sync with stages, types and levels of automation	(Rovira, McGarry, & Parasuraman, 2007) (Parasuraman & Riley, 1997) (Parasuraman, Sheridan, &Wickens, 2000)
Money Constraint	High R& D cost. High resource cost of installing super-computing devices. Non-linkage to economic benefits	(Klein, Woods, Bradshaw, Hoffman, &Feltovich, 2004). (Rajput &Gautam, 2010; Boehm-Davis, Curry, Wiener, & Harrison, 2015) (Hoffman, 1999).
Management Constraint	Resistance to change. Political, Ethical, Social and Legal constraints. Low degree of involvement from automation conception to implementation. Architect/Developer bias. Ill-stalled Trust.	(Barker, Gohmann, Guan, &Faulds, 2009) (Wagner, 2014) (Cascio, Mariadoss, &Mouri, 2010). (Skitka, Mosier, & Burdick, 2000) (Jr., Thelen, & Hodge, 2005).

Men-Machine Interaction Constraint	Changing lead roles in men-machine work environment. Susceptibility of humans to incorporate Learn-Unlearn-Relearn paradigm. Complexity of man-machine interaction. Problem of men-machine coordination.	(Baldwin & Shultz, 1955; Agha, 1986). (Nazira, Klugeb, &Manca, 2014) (Bolton, Jim´enez, Paassen, & Trujillo, 2014; Bainbridge, 1983) (Sarter, Woods, & Billings, 1997)
Measurement Constraint	Lack of automation impact measurement tools. Missing drivers of automation for analyze automation trends	(Poston & Grabski, 2001) (Terwiesch & Ganz, 2009).
Mechanism Constraint	Non-availability of industry specific literature on who, when, where, why, and how aspect of automation planning and implementation. Complexity involved in automation planning.	(Cernetic & Strmcnik, 1992). (Middleton, 2000)

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