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Improving the Chances of Success of Resource Hungry Self-Service BI Systems in the Post Covid Context: With a Focus on 'Satisfaction'

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As organizations invest trillions in Information Technology (IT) to cater to growing demands of customers, the complexity of Business Intelligence Systems expand, thereby enabling businesses to power efficient decisions driven by data. In a context, where considerable resources are invested by organizations to enable access to data, information & insights through the self-service route for their employees, there is a critical need to improve the chances of success of resource hungry self-service Business Intelligence (BI) systems (like PowerBI, Tableau etc.) to unlock value from the investments. Even though 'Satisfaction' is the most frequently used construct to explain IT/Information System (IS) Continuance Intention, in the post Covid context, our current understanding of post-adoption 'Satisfaction' of self-service BI systems in a bandwidth constrained environment (like home) is in-adequate to enable targeted interventions to drive usage. In this study, we review the diverse literature on Satisfaction to establish its central role in driving the success of self-service BI systems. This would inspire future research into the relative influence of System Quality measures on Satisfaction thereby providing actionable guidance to Human Computer Interaction (HCI) designers & product teams.

Keywords: Satisfaction, Self-Service, Business Intelligence, System quality, Visual Appeal, Response Time

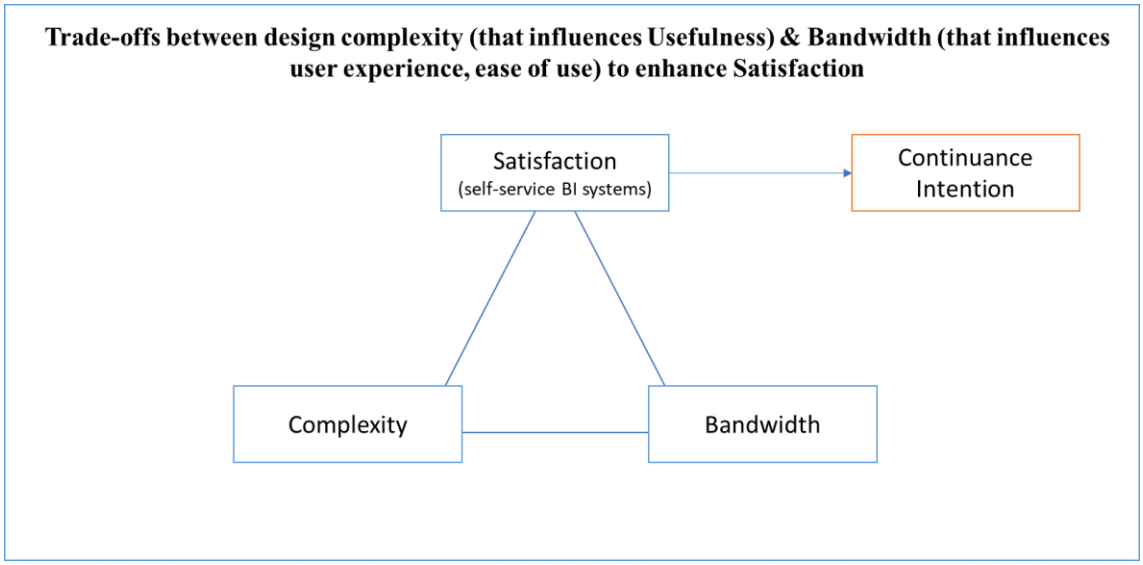
Introduction:

As several millions of employees get accustomed to the post-COVID-19 new normal, many organizations are making it increasingly clear that in the new normal, there would be a hybrid work culture where there wouldn't be requirements to be in workplaces on all days. A lasting increase in working from home could have far reaching implications to the way employees engage with information systems, tools and technologies and the way they are designed. Poor or inadequate bandwidth in developing economies is a reality – add to this, there is a need to share the bandwidth with partners, kids, roommates. In a developing economy like India, more than 2/3rd of the employees falling under 5-year experience bracket, work with network bandwidths (at homes) that cannot be considered optimal (Keelery, 2020). The broadband connectivity available at an average home, is not enterprise class where a distinctively superior experience is available. It is abundantly clear that network resources available in an office setting cannot be easily replicated in remote work settings by an employer.

Even in times of such crisis, Gartner forecasts a 6.2% increase in IT spending worldwide that is pegged at $3.9 trillion (Gartner,2021). To satisfy the growing demands of customers, businesses are expanding the complexity of their business intelligence systems to power efficient decisions powered by more data & advanced data models. This is key to gaining performance efficiency (Bradley , 2012). As organizations invest considerable resources to enable access to data, information & insights through the self-service route for their employees, the chances of success and continued use of resource hungry information systems crunching big data in non-enterprise grade bandwidth are under question.

To realize returns from the investments made in technology, its continued & sustained use is of paramount significance. Securing the trust and confidence of an existing user base is a lot more cost effective when compared to adding new users(Zhang, Zhang, Ordóñez de Pablos, & Sun, 2014). While we see an increasing trend in studies that focus on IT/IS continuance intention(Shaikh & Karjaluoto, 2015), we can at best, term our understanding of usage behaviours(post-adoption), as in its nascent development stage (Jasperson, Carter, & Zmud, 2005). The decision to continue using an Information System is longitudinal in

nature, where a sequence of multiple individual decisions to use an information system regularly, play an important role (Limayem, Hirt, & Cheung, 2007). With a significant shift in the context post Covid-19, where hybrid work environments are a reality, information systems like self-service BI systems designed in the pre-Covid era leveraging the theories pre-Covid may need validation of relevance.



Expectation Confirmation Model, also called as ECM, is variation of Expectation confirmation Theory (ECT) that intends to explain the drivers of satisfaction and continuance intention of Information system users. It highlights that, expectations get modified over time due to which the role played by post consumption expectations are important. ECM establishes that Satisfaction is actively influenced by confirmation of expectations and post-usage Perceived Usefulness (Bhattacherjee, 2001a). The DeLone & McLean IS success model further confirms the antecedents of Satisfaction and Continuance intention include Information Quality, System Quality and Service Quality. Though there are a few studies that have leveraged Perceived System Quality while extending ECT based IS continuance, there is a clear dearth of research in IS Continuance of self-service BI systems.

If we look at the key research variables used thus far, in the research on Continuance Intention of IT/IS (Nabavi, Taghavi-Fard,, Hanafizadeh, & Taghva, 2016), it can be observed that Satisfaction was the most dominant influencer of IS Continuance Intention. The other key influencers included Perceived Usefulness, confirmation/Disconfirmation, Perceived Ease of Use, Attitude, Habit, Perceived Enjoyment etc. This emphasizes the central role of Satisfaction in studying Continuance Intention of Information Systems, thereby also a key influencer of usage of self-service BI systems. So, on one side, we have a dearth of research in IS continuance of self-service BI systems and on the other side, it is important to evolve the understanding of a a key construct like 'Satisfaction' in the evolving context post-Covid-19.

Therefore, the research question is: How should a HCI designer maximize Satisfaction to enable continuous usage of self-service BI systems by striking the right trade-off between design complexity and User Experience? For an evolving complex business environment and an increasing availability of more data, a certain level of complexity in design is required to comprehensively answer the evolving business questions and reach the required levels of usefulness. But, as the data model & design complexity increases, there is an impact on the user experience, when operating in sub-par bandwidths due to poorer than average response times. One option is to compensate for user experience with 'Visual Appeal' but addition of more graphics and visual objects tends to increase the response time, when tools operate in non-enterprise class bandwidths or otherwise. This puts the HCI designer at the centre of making the trade-off decisions between design complexity, response times, visual appeal etc and hence there is an

accentuated need to enable these decisions with data to reduce the role played by judgements.

To comprehensively understand the role played by satisfaction in IS literature in post-Covid era, we start with the theories of motivation, explore early attempts to dis-aggregate IS success, work through the evolution of IS from traditional data processing to end user computing, understand the measures of Satisfaction, focus on the evolving role of system quality measures influencing satisfaction and identify opportunities for further research that can add to the literature & enable action oriented interventions by HCI practitioners. While we approach the literature review with a focus on self-service BI systems, the concepts may also apply to other areas of IS, like data mining, ERP, Natural Language Querying, Executive Information systems, Data base management systems (DBMS), decision support systems etc.

Overview of Literature:

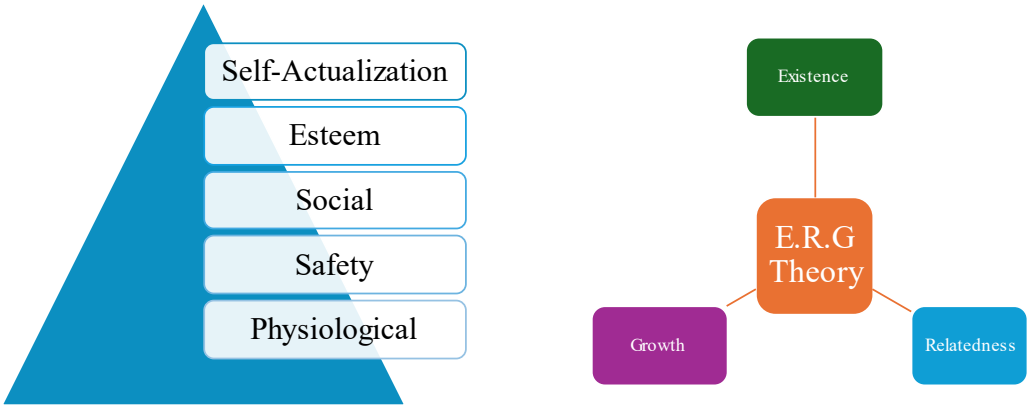
Theories of Motivation

To explore Satisfaction in the literature, Maslow's theory of motivation (Maslow, 1943) is a good place to start and we follow this, with Alderfer's ERG - Existence, Relatedness and Growth theory (Alderfer, An empirical test of a new theory of human needs, 1969). Maslow hypothesizes the existence of a hierarchy of human needs. These are Physiological, Safety, Social, Esteem and Self-actualization. A higher order need would assume dominance only when a lower order gets satisfied.

E.R.G Theory posits Maslow's five categories into "Existence", "Relatedness" and "Growth" needs (Alderfer, Existence, relatedness, and growth., 1972). E.R.G. theory assumes that there are three critical needs that humans strive to meet which comprises of obtaining the material existence needs, maintaining the interpersonal relatedness with significant people and look for personal development and growth opportunities (Alderfer, An empirical test of a new theory of human needs, 1969). A significant contrast in Alderfer's ERG theory in comparison with Maslow's is his disbelief in a hierarchy of needs – where a lower order need doesn't have to be satisfied for a higher order need to emerge and all sets of needs are active in humans.

Figure 2

Maslow's hierarchy of needs vs Alderfer's ERG Theory of motivation

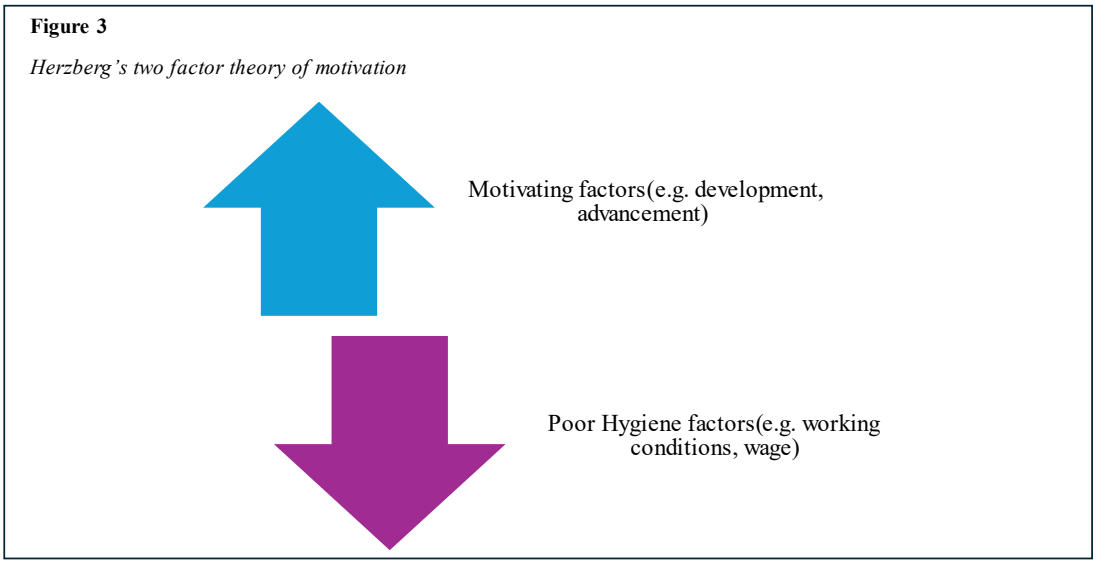


Herzberg, in his two-factor theory, viewed dis-satisfaction and satisfaction as different constructs which was a shift from how Maslow and Alderfer handled satisfaction (Herzberg, Mausner, & Snyderman, 1959). Herzberg hypothesized that humans would first attempt to secure 'hygiene' needs without which they are not happy. As soon as the 'hygiene' needs are satisfied, the satisfaction would be temporary as the effect of 'hygiene' needs would be temporary. It is not possible to motivate people with 'hygiene' needs. People are truly motivated by 'motivators' like development, advancement etc. Herzberg showed that there are different factors that influence dis-satisfaction and satisfaction. Herzberg emphasized that the factors that generated dis-satisfaction are not opposite of

factors that motivated people (Herzberg, Mausner, & Snyderman, 1959).

Figure 3

Herzberg's two factor theory of motivation



If we extend the motivation theory analogies to 'what motivates users to continuously use self-service BI systems', there would be some core and basic needs that an IS would be expected to fulfil and these could include tolerable response time, accuracy, usefulness, relevance etc. Once these needs are fulfilled, a higher order need like 'ease of use', 'perceived enjoyment', 'visual appeal' or 'flexibility' could set in dominance. As per ERG theory, if the fulfilment of a higher-order need is subdued (ex. Perceived enjoyment or Visual Appeal), there is an increase in desire for satisfying a lower-order need (ex. accuracy, response time, security etc.). As per Maslow's theory (Maslow, 1943), an individual may continue to remain at a particular need level until that need is satisfied. This implies that if a lower order need like 'acceptable response time' is not satisfied, the user may not even graduate to a higher order need.

With regards to 'Satisfaction' with IS in general and more particularly, with regards to 'Satisfaction' of 'self-service BI systems', while 'System Quality' stands out as a prominent driver, there is no decomposed hierarchy of system quality features or sub-constructs that exist in the current IS literature due to which it is not possible for a IS researcher or a practitioner to identify which is a lower order need and which is a higher order need. There is no clarity on whether the hierarchies are dynamic and flexible depending on context, age, gender etc.

Dis-aggregation of IS Success: Early attempts

(Alloway, 1980), while attempting to define success for data processing surveyed 114 managers across 6 firms to identify 26 criteria for 'Data processing' success. Based on user ratings on importance and performance, Top 10 criteria for actions were identified and these included System Quality , report contents (accuracy, relevance, currentness, flexibility) etc. The Top 10 criteria also included development for more inquiry systems for self-service where users can have access to adhoc/flexible reports, on an as-needed basis. Flexible inquiry systems would minimize the problems with outdated report contents - users' can modify the contents of their reports whenever they need change. This is the first time in the literature where flexibility driving self-service was identified as an important driver of success for data processing information systems (Alloway, 1980). Attitudes of users, general education program on data processing and 'Responsiveness to user's needs' were the other prominent elements that determined the success of data processing information systems.

The real contribution from Alloway's study (Alloway, 1980) is the dis-aggregation of overall success so that it is possible to dig deeply into relative importance of the drivers of success (of

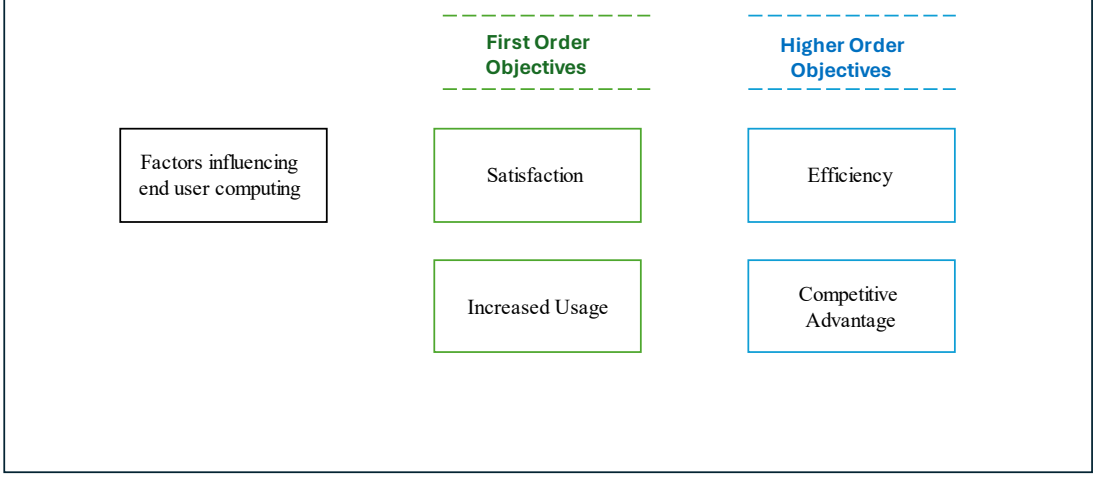
data processing information systems). This was intended to drive the right trade-off decisions across the elements that drive success and minimize causes of low success. Alloway saw no relationship between importance of a criteria and its performance and found the basic rule of 'most important tasks getting maximum resource allocations' was violated (Alloway, 1980).

Shift from traditional data processing to end-user computing:

In the 1980s, one of the significant phenomena in the IS industry was end- user computing that showed signs of rapid growth (Doll & Torkzadeh, The measurement of end-user computing satisfaction, 1988). Researchers, in their quest to study the factors influencing end user computing, identified satisfaction of users and increased usage as the core objectives in the implementation phase of end user computing (Henderson & Treacy, 1986). These were the first order objectives that had to be met before evolving to higher order objectives like efficiency, competitive advantage etc. as the organization gains more experience with the IS. User Satisfaction was a measurable surrogate to utility in decision making and it was measurable. Especially, in a scenario, where the IS usage is involuntary, Satisfaction becomes a more appropriate measure in comparison to system usage (Doll & Torkzadeh, The measurement of end-user computing satisfaction, 1988).

Figure 4

End user computing influencers : Henderson & Tracey (1986)



The emergence of 'end user computing' where users directly interact with the system marked a significant departure from the tradition data processing environment where users were engaging with the system indirectly through intermediaries like analysts, programmers, or operations teams. As an example, the man-machine interface now becomes a critical area to focus on which was quite irrelevant in the traditional data processing environment. There was a shift where the information systems teams started focusing on empowering and enabling end users to independently solve many of their problems.

As the demand for new information systems exceeded the available 'Data processing' capacity in the organization, one solution was to massively expand the DP personnel which was not a favoured route due to the associated costs and the other approach is to allow end users to function as their own developers by self-serving their requirements (McLean, 1979). The approach to self-serve requirements accelerated the journey of end-user computing driving the evolutions right up to self-service Business Intelligence. As we are focusing on self-service BI systems, it is critical to register this shift and understand the evolving influencers of Satisfaction.

Measures of User-Satisfaction:

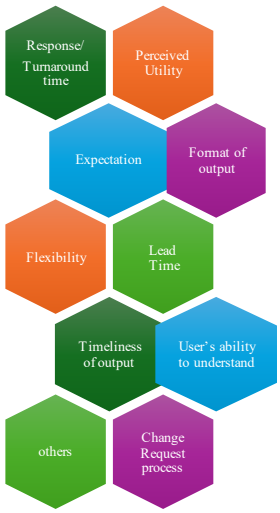
Bailey & Pearson – 1983

User Information Satisfaction (UIS) is a measure that focusses on the way users views their information system, instead of the technical quality of the system (Ives, Olsen, & Baroudi, 1983). An

information system may be "good" but if the users view or perceive the system as "poor", then it is a "poor" information system. Pearson identified 39 distinct factors that contributed to Information Satisfaction. Some of the significant items that are of interest to our current study include the below. (Bailey & Pearson, 1983)"

Figure 5

Measures of User Satisfaction: Bailey and Pearson (1983)



It is quite evident that the earliest scales available for measuring Satisfaction had a prominent space for "Responsiveness/Timeliness (in the form of Response/Turnaround time, time for new systems development, Output timeliness)", "User Experience" (in the form of format of Visual output, Flexibility, User understanding), "Expectation" and "Perceived Usefulness/Utility".

Bailey & Pearson define 'Response Time' as the time elapsed for terminal type entry or request. The elapsed time for program execution requested by the user and the return of output to the user is referred as Turnaround time (Bailey & Pearson, 1983)

Ives, Olsen & Baroudi – 1983

(Ives, Olsen, & Baroudi, 1983), in their endeavor to develop a more valid form of Pearson's instrument, surveyed 280 managers who were part of a US manufacturing organization and generated a more condensed version of the instrument basis a factor analysis of the Bailey and Pearson instrument. Ives et al teased out 3 factors: (Ives, Olsen, & Baroudi, 1983)"

1. EDP (Enterprise Data processing), concerned staff and services
2. Information product
3. Involvement or Knowledge"

This instrument wouldn't suit an end user computing or a self-service environment as it was designed for the more traditional data processing environment. But this establishes that user's derive satisfaction from the information product or system and hence its characteristics and features become a focus of study to understand user satisfaction. Involvement of users is another key factor of interest which highlights those constructs like 'perceived enjoyment', "experience", "Visual appeal of output formats", "Response Time" could be of interest. These amplify user involvement, and they can have a profound influence on user satisfaction.

In an end-user computing or self-service BI context, it is important to not ignore the man machine interface's ease of use aspects(Doll & Torkzadeh, The measurement of end-user computing satisfaction, 1988). The end users can become super users if they find the application easy to use that would enable them to take advantage of the full range of capabilities of the system. An appealing and easy to use interface may improve productivity and enable decision makers to examine more alternatives for their decision choice by encouraging involvement. In the self-service BI context, end users have less or no interactions with analysts/programmers or designers who compose

the information system. Hence the factors related to 'Data processing staff and services' seem less relevant in an end user computing context.

Doll & Torkzadeh – 1983

(Doll & Torkzadeh, The measurement of end-user computing satisfaction, 1988) compiled a 40-point instrument to measure end user perceptions by factoring in constructs like "ease of use" which were missing in the earlier studies. This eventually condensed into a 12-item scale that had five prominent factors as below: (Doll & Torkzadeh, The measurement of end-user computing satisfaction, 1988) "

1. Content
2. Format
3. Accuracy
4. Timeliness
5. Ease of Use"

The 'format' emerged as a prominent influencer of user satisfaction along with Timeliness and Ease of Use. These are all related to "System Quality" which highlights the central role played by System Quality & its components in influencing Satisfaction. This demonstrates evolution in the "User Satisfaction" research and highlights the journey towards a standard measure of end user satisfaction, focused on specific applications.

Since we are dealing with end user satisfaction, it is important to explore the nature and extent of involvement of end users in the system design as this may be critical to drive Satisfaction (Doll & Torkzadeh, The measurement of end-user computing satisfaction: theoretical and methodological issues, 1991). In the design of information systems that are computer based, user involvement is an accepted essential principle, and the literature has devoted attention to the connections between IS success and user involvement (Doll & Torkzadeh, The measurement of end-user computing satisfaction: theoretical and methodological issues, 1991). If we explore the recommended 8-item instrument (Doll & Torkzadeh, The measurement of end-user computing satisfaction: theoretical and methodological issues, 1991) for measuring end user involvement, it explores

- If users were involved in determining System Objectives (e.g., Response Time, Timeliness, data currency etc)
- If user were involved in developing output formats (e.g., alignment, measures, Visual Appeal etc)

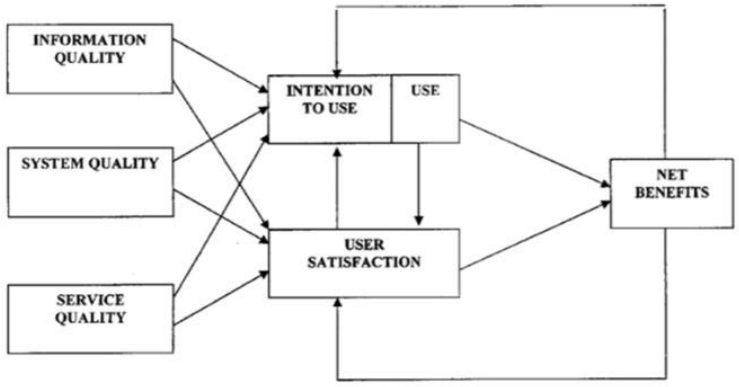
In an organization, anyone involved in making decisions would need access to data and insights and hence it is a broad spectrum of users. It is not practical to involve all users and hence a small cross section of 'supposedly' representative users is involved in the design of outputs and in specifying system objectives. This, in many cases, is not likely to represent the diverse needs of the target user base as we are living in an era of personalization where users expect extensive flexibility, best in class response time, a visual appeal that suits their taste at affordable costs. Since every user is working on their own sweet intersection point of their requirements, the system features can become critical drivers of satisfaction.

Interface Satisfaction:

DeLone & McLean identified System Quality alongside Information Quality as the core constructs that drive user satisfaction, system use, individual and organizational impact (DeLone & McLean, 1992). Their model was subsequently enhanced with the inclusion of Service Quality while a single variable called 'Net Benefits' converged the individual and organizational impacts. An attitude called "Intention to Use" was suggested as a worthwhile replacement of 'System Use' (which is a behavior).

Figure 6

Updated DeLone & McLean IS Success Model (2003)



Using Mason's taxonomy (Mason, 1978), DeLone and McLean identified System Quality as one of the core dimensions of success of Information Systems which represented the technical level while the semantic level of success was represented by information quality (DeLone & McLean, 1992). All the desirable characteristics of an IS was represented by System Quality that included ease of use, intuitiveness, system reliability, response times, ease of learning, system flexibility, sophistication etc.

DeLone and McLean model of IS Success was adapted by (Garrity, Sanders, & eds, 1998) who identified User Satisfaction to include four sub dimensions:"

1. Interface Satisfaction
2. Decision Support Satisfaction
3. Quality of work life Satisfaction
4. Task Support Satisfaction"

(Garrity, Sanders, & eds, 1998) IS Success model factors in the quality of work life of users who are impacted by Information Systems. This dimension is even more relevant in the post-Covid 19 context where the lines between work and life has thinned down with extensive hybrid work cultures. More time spent on the Information System translates to increased working hours that can impact the work life balance. This is a factor that designers would need to consider. The dimensions like 'task support satisfaction' manifests in the form of 'service quality' in the DeLone and McLean model while 'decision support' manifests as 'Net benefits. 'Interface Satisfaction' is an interesting new dimension that was introduced by Garrity & Sanders(Garrity, Sanders, & eds, 1998) that closely links to the 'Visual Appeal' & 'Perceived Usefulness' that is part of the conceptual model of our study. The end user's impression of the format, presentation, efficiency and ease of use are captured by Interface Satisfaction. Basis the symbolic representation theory to solve problems, symbolic representations are of three types that include linguistic representation, Visual imagery representation and exploratory reasoning. Whenever we leverage an information system to enable search of information and a subsequent evaluation of multiple alternatives, the symbolic representations help direct attention and narrowing down to decision choices amongst alternatives. Hence, poorly designed menus, navigations, and complexity in comparing alternatives can impede decision support. High interface quality is critical to reduce cognitive overload and avoid dis-orientation while evaluating alternatives (Kim, Garrity, & Sanders, 2002).

Interface Satisfaction – Measurement items (Kim, Garrity, & Sanders, 2002)*"*

- The information is Understandable and Clear.
- This information system is easy to use.
- It was easy to learn to use this information system.
- It would be easy for me to become skilful at using this information system
- This information system is user friendly.

- My interaction with this information system was Understandable and Clear
- I found it easy to get this information system to do what I want it to do"

(Ditsa & MacGregor, 1997) studied multiple models on user satisfaction associated with information systems and identified the key factors included the user interface features of the IS, the information quality provided by the IS and the nature of support provided for the IS. (Mahmood, Burn, Gemoets, & Jacquez, 2000) performed a meta-analysis of the empirical literature on variables affecting satisfaction of end users connected with information technology by studying 45 end user satisfaction models published over a 12 year period from 1986 and 1998 and the factors affecting user satisfaction were categorized as below (Mahmood, Burn, Gemoets, & Jacquez, 2000) "

Figure 7

Factors affecting User Satisfaction Mahmood, Burn, Gemoets, & Jacquez (2000)

User Background related factors	User Skills
	User Experience
	User Involvement during the development of the system
Perceived benefits and Convenience related factors	User Expectations
	Ease of Use
	Perceived Usefulness
Organizational support and encouragement related	User Attitude towards IS
	Perceived Attitude towards Top Management
	Organizational support

It is evident that perceived benefits and convenience related factors like 'Expectations', 'Ease of Use', 'Perceived Usefulness' alongside user specific factors like their skills, gender, age can be key influencers of Satisfaction from a self-service BI system.

Web Customer Satisfaction & WEBQUAL

Customers dissatisfied with site retrieval and mechanisms of interface delivery (like cluttered pages) are highly likely to leave the site even if the site contains information of high quality. Customers make inferences about the attractiveness of products from design elements such as fun and ease of navigation, speed of content retrieval etc. that play a role in satisfying the needs of customers. Hence web-customer satisfaction is a function of the website's information content quality and the system's performance in delivering the information. Usability, navigation, interactivity, and responsiveness (Access) are core dimensions that explain system quality while perceived usefulness, relevance, timeliness, reliability, and scope represent dimensions of information quality.

The theories that are associated with Information Systems can be applied to Websites as they are also a form of information system. In a similar way, the learnings from the quality measurement of websites can be extracted and applied to other areas in the information systems field. Self-Service BI interfaces have a rich similarity to websites and hence there is rich inspiration that can be derived from WEBQUAL (a measure of website quality) basis the work done by (Loiacono, Watson, & Goodhue, 2007).

Theory of Reasoned Action (TRA) and Technology Acceptance Model (TAM) were the starting points in the development of a measure for website quality. Davis proposed Technology Acceptance Model (TAM) by applying Theory of Reasoned Action (TRA) to 'computer technology' use. (Davis, 1989) observed that the relationship between beliefs and intentions is not completely mediated by attitudes, and hence belief could be a direct predictor of intentions. As Subjective norms were an insignificant predictor for computer systems, the focus shifted entirely on "usefulness" and "ease of

use" as the primary predictors. It was important to determine the multiple distinct dimensions of "ease of use" and "usefulness" to predict the re-use of a website.

The website quality measure (WEBQUAL) has 12 core dimensions and the dimensions along with their descriptions are available below. (Loiacono, Watson, & Goodhue, 2007)"

1. Informational fit-to-task - The degree to which users regard that the information provided by the Web site cover their needs
2. Trust - information privacy/security
3. Tailored communications – tailoring communications to meet the user's needs
4. **Response time -** Time to get a response after a request or an interaction with a Web site.
5. **Ease of understanding** - Easy to understand and read
6. **Visual appeal** - The aesthetics of the Web site.
7. Intuitive operations - Easy to navigate and operate
8. Innovativeness - The uniqueness and creativity of a Web site
9. Consistent image – Non existence of dissonance by an incompatible image with that projected by the firm through other media
10. Emotional appeal – Intensity of involvement/ emotional affect of using the Web site.
11. Relative advantage – in comparison to the other means of interacting with the company
12. On-line completeness – most or all necessary transactions completed on-line (e.g., purchasing over the Web site)"

The WEBQUAL instrument is quite a relevant instrument for our area of study, and it was developed based on interviews with Web designers and visitors as well as based on extensive literature review. TAM identifies general beliefs like 'ease of use' and 'usefulness' but there are additional factors that drive the use of web (e.g., entertainment value). It is important to identify the concrete aspects of a site that makes the experience for uses easy and steps up the usefulness quotient (Goodhue & Thompson, 1995). Such clarity is critical if we intend to empirically discover whether certain aspects are more critical and significant in comparison to others in determining user behavior (Loiacono, Watson, & Goodhue, 2007).

This approach can inspire studies on the detailed components of System Quality that determine the continuance intention and satisfaction with self-service BI systems. Without knowing the finer details than "ease of use" or "usefulness", it is difficult for the practitioner to know what kind of changes need to be made with the system or the website that is rated low in "ease of use" or "usefulness". WEBQUAL highlights that 'Response Time', 'Visual Appeal', 'ease of understanding' are core dimensions that influence satisfaction and the same can be extended to the study of satisfaction from self-service BI systems.

Discussion:

When we extend the theories of motivation to the field of Information Systems, we can deduce that there can be some core and basic needs that an IS would be expected to fulfil (e.g., tolerable Response time) before a higher order need like 'enjoyment or 'Visual Appeal' could set in dominance. This implies that if a lower order need like 'acceptable response time' is not satisfied, the user may not even graduate to a higher order need. There is a clear Research Gap in IS literature- while 'System Quality' stands out as a prominent driver in many IS studies, there is no decomposed hierarchy of system quality features or sub-constructs that exist in the current IS literature due to which it is not possible for an IS researcher or a practitioner to identify which is a lower order need and which is a higher order need. This is a call for potential researchers to evolve a decomposed hierarchy of system quality features.

(Alloway, 1980) attempted to dis-aggregate the overall success of data processing systems so that right trade-offs can be enabled between the success criteria elements. There was no relationship found between the importance attributed to a criterion (alongside the allocation of resources to the same) and its actual performance. Building on this, it is plausible that a similar lack of relationship could exist between the allocation of resources to sub-constructs of system quality and their actual importance in driving Satisfaction and Continued usage of information systems

End user Satisfaction was a surrogate to utility in decision making and it was measurable. Especially, in a scenario, where the IS usage is involuntary, Satisfaction becomes a more

appropriate measure in comparison to system usage (Doll & Torkzadeh, The measurement of end-user computing satisfaction, 1988). A departure from traditional data processing was marked by the arrival of end user computing where there was a direct interaction between the system and users without the need for intermediaries. As an example, the man-machine interface now becomes a critical area to focus. While this was quite irrelevant in the traditional data processing environment. As demand for new information systems accelerated, expanding data processing personnel was no longer a favored route due to associated costs and there was a shift towards self-serving requirements. It is critical to register this shift and understand the evolving influencers of Satisfaction which is a core construct of interest as we move towards self-service.

It is quite evident from (Bailey & Pearson, 1983) studies that the earliest scales available for measuring Satisfaction had a prominent space for "Responsiveness/Timeliness "(in the form of Response/Turnaround time, time for new systems development, Timeliness of output)", "User Experience" (in the form of format of Visual output, Flexibility, User understanding), "Expectation" and "Perceived Usefulness/Utility".

(Ives, Olsen, & Baroudi, 1983) establish that user's derive satisfaction from the information product or system and hence its characteristics and features become a focus of study to understand user satisfaction. Involvement of users is another key factor of interest which highlights those constructs like 'perceived enjoyment', "experience", "Visual appeal of output formats", "Response Time" could be of interest. These amplify user involvement, and they can have a profound influence on user satisfaction. In an end-user computing or self-service BI context, it is important to not ignore the man machine interface's ease of use aspects (Doll & Torkzadeh, The measurement of end-user computing satisfaction, 1988). The end users can become super users if they find the application easy to use that would enable them to take advantage of the full range of capabilities of the system. An appealing interface that is easy to use may improve productivity and enable decision makers to examine more alternatives for their decision choice by encouraging involvement. It is important to provide due consideration to "Perceived Ease of Use", which is not a part of IS Success Model & Expectation-Conformation theory, in the context of self-service BI systems.

(Doll & Torkzadeh, The measurement of end-user computing satisfaction, 1988) compiled a 40-point instrument to measure end user perceptions by factoring in constructs like "ease of use" which were missing in the earlier studies. This eventually condensed into a 12-item scale where format re-emerged as a prominent influencer of user satisfaction along with Timeliness and Ease of Use. These features of system quality need attention when researchers try to evolve a decomposed hierarchy of system quality features. The desirable characteristics of an IS, represented by System Quality, include ease of use, intuitiveness, system reliability, response times, ease of learning, system flexibility, sophistication etc (DeLone & McLean, 1992)

(Garrity, Sanders, & eds, 1998) identified User Satisfaction to include four sub dimensions: Interface Satisfaction, Task Support Satisfaction, Quality of work life Satisfaction, Decision Support Satisfaction (Garrity, Sanders, & eds, 1998). The nature of impact created by an IS on a user's quality of work life is factored in IS Success model. This dimension is even more relevant in the post-Covid 19 context where the lines between work and life has thinned down with extensive hybrid work cultures. More time spent on the Information System translates to increased working hours that can impact the work life balance. This is a factor that designers would need to consider in today's context. Interface Satisfaction' is an interesting new dimension that was introduced by (Garrity, Sanders, & eds, 1998) that closely links to the 'Visual Appeal' & 'Perceived Usefulness'. The overall impression of the end user that is created by the presentation, ease of use, format and efficiency is captured by Interface satisfaction. Whenever we leverage an information system to drive information search and the cross evaluation of multiple alternatives, the symbolic representations help direct attention and narrowing down to decision choices amongst alternatives. Hence, poorly designed menus, navigations, and complexity in comparing alternatives can impede

decision support. High interface quality is critical to reduce cognitive overload and avoid dis-orientation while evaluating alternatives (Kim, Garrity, & Sanders, 2002). This learning would serve as an input into the design of 'experimental' research methods that try and decompose the hierarchy of system quality dimensions.

(Ditsa & MacGregor, 1997) studied multiple models on user satisfaction associated with information systems and identified the key factors included the user interface features of the IS, the information quality provided by the IS and the nature of support provided for the IS. This clearly emphasizes the critical role played by the 'User Interface' and the lack of specific focus to 'User Interface' in IS Success Model & Expectation confirmation Model. There is a potential opportunity to plug this research gap & contribute to IS literature. (Mahmood, Burn, Gemoets, & Jacquez, 2000) performed a meta-analysis of the empirical literature on variables affecting satisfaction of end users connected with information technology by studying 45 end user satisfaction models published over a 12-year period from 1986 and 1998 and one of the three categories of factors affecting user satisfaction included 'Perceived Benefits and Convenience related factors. This emphasizes the importance of perceived benefits and convenience related factors like 'Expectations', Ease of Use', 'Perceived Usefulness' alongside user specific background related factors like their skills, gender, age etc.

Customers dissatisfied with site retrieval and mechanisms of interface delivery (like cluttered pages) are highly likely to leave the site even if the site contains information of high quality. Customers make inferences about the attractiveness of products from design elements such as fun and ease of navigation, speed of content retrieval etc. that play a role in satisfying the needs of customers. Hence web-customer satisfaction is a function of the website's information content quality and the system's performance in delivering the information. There is a rich similarity with regards to IS Research and WEBQUAL in terms of how the drivers of 'Satisfaction' construct are dealt with. The theories that are associated with Information Systems can be applied to Websites as they are also a form of information system. In a similar way, the learnings from the quality measurement of websites can be extracted and applied to other areas in the information systems field. Self-Service BI interfaces have a rich similarity to websites and hence there is rich inspiration that can be derived from WEBQUAL (a measure of website quality) basis the work done by (Loiacono, Watson, & Goodhue, 2007). WEBQUAL has 12 core dimensions that predict re-use, and the core dimensions include 'Response Time', 'Visual Appeal', 'Intuitive Operations' and 'Ease of Understanding'.

To measure Information system's effectiveness, User Satisfaction is deployed as one of the core surrogate measures (Gatian, 1994). User Satisfaction with an IS has been shown to drive enhanced decision performance and efficiency that highlights the pivotal role played by the 'Satisfaction' construct (Gatian, 1994). While (DeLone & McLean, 2003) do bring a wide variety of satisfaction drivers like system quality, information quality, service quality etc. together, it is important to note that there are complex relationships that bind attitudes (like Satisfaction) and behavior (system use). Careless interpretations or improper questionnaire choices can result in poor managerial decisions and research implications (Gatian, 1994). This clearly highlights that we should focus on the specific area of study related to System Quality to capture the effects on Satisfaction. (Gatian, 1994) highlights that if the researcher intends to analyze the relationships between two specific phenomena, then they need to control environmental factors. With this, (Gatian, 1994) calls for experimental research where participants must perform a decision-making task using an IS having both bad and good decision outcomes. The relationships between Satisfaction and performance needs to be measured post the users having performed the decision-task with the system.

While user satisfaction has assumed a core pivotal role in the evaluation of IS effectiveness (Srinivasan, 1985), user satisfaction alone is insufficient for a model to capture the complete meaning of IS effectiveness as it fails to consider the role played by user behavior (Melone, 1990). Hence, there is a need to consider output-oriented criteria over and above affect oriented measures.

Conclusion and future research directions:

This article emphasizes the need to review Satisfaction literature in the post-covid context with a fresh lens while highlighting the central role played by 'Satisfaction' in the success of self-service BI systems. Staring with the theories of motivation, we travel through the transition from traditional data processing to end user computing and explore the rich similarities between WEBQUAL & IS Research to understand how the construct of 'Satisfaction' has been dealt with and its evolution. We highlight the non-existence of a decomposed hierarchy of system quality features & relative ranking of SYSTEM QUALITY features that influence Satisfaction with self-service BI systems. If this research gap is bridged, it can be a huge benefit for practitioners to target investments on those features that maximize adoption & increased usage of self-service BI systems. The article highlights the need to have a 'user centric' approach & explore constructs that amplify 'enjoyment' & 'experience' like 'Visual appeal of output formats", "Response Time" etc. which haven't had enough attention in IS Success Models influenced by 'Expectation Confirmation' theories. User specific factors like their skills, gender, age can be key influencers of Satisfaction from a self-service BI system & this is an opportunity for potential researchers. (DeLone & McLean, 2003) bring together a wide variety of satisfaction drivers, but it is noted that we should focus on a specific area of study (example: System Quality) to capture the effects of sub-constructs on Satisfaction Considering the complex relationships in existence, we call for experimental research with a need to control for other factors to analyze relationships between specific phenomena and understand the relative influence of SYSTEM QUALITY features on Satisfaction. In a post Covid context, where many organizations have employees adopting a hybrid work culture and access self-service BI systems with non-enterprise class bandwidths, focused experiments can help unearth if there are fundamental shifts in the relative importance of the features of SYSTEM QUALITY that influence satisfaction with self-service BI systems.

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