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Correlating a User Experience System to Product Success

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Abstract

After reviewing many products from a systems thinking perspective, a pattern has emerged in which successful products seem to more holistically address non-functional requirements (NFRs) that emphasize a user experience (UX) system. To validate this hypothesis, key NFRs – which are believed to contribute to the UX – have been identified, and pairwise comparisons will need to be made between test and control products.

To determine whether there is correlation between a UX system and success, a Spearman correlation will need to be performed in which the UX system score for each product is informed by surveys while the success of each product is informed by objective metrics.

This paper will demonstrate one subjective analysis of the independent variable and an objective analysis of the dependent variable for one pairwise comparison. Additionally, to demonstrate the mechanics of the Spearman correlation, the results of a second pairwise comparison will be included; however, its analysis will not.

Thereby, identifying the complete set of test and control comparisons and investigating whether UX systems – which holistically incorporate NFRs – and success are correlated will be the emphasis of future research and is beyond the scope of this paper.

Keywords*:* User Experience, Systems Engineering, Non-Functional Requirements, Systems Thinking, Requirements, Product Success

Introduction

Development teams are well-served in using the systems engineering process to develop and deploy new products. Translating stakeholder requirements into system requirements is a key step within systems engineering. Therefore, fully understanding stakeholder requirements and embedding those requirements within the design of a product is critical to success.

However, when considering stakeholder requirements, it is much more intuitive to focus on functional requirements (i.e., those requirements which technically state how a product is to perform or what a system is supposed to do) than non-functional requirements (i.e., "quality attributes or characteristics that are desired in a … [product] …, that define how a … [product] … is supposed to be" SEBoK, 2021)

Problem Formulation

With the amount of money and time that can be spent on product development efforts, every effort should be made to understand why certain efforts succeed while others do not. For example, with all of Microsoft's resources and talent, the Zune (a music player developed by Microsoft) was not nearly as successful as anticipated; however, the iPod (a music player developed by Apple) was very successful.

Why did the iPod succeed while the Zune failed?

After reviewing various products from a systems thinking perspective, a pattern has started to emerge in which successful products more holistically address non-functional requirements that emphasize a user experience system – please see Figure 1, which will be explained in more detail in subsequent sections. Also, for the purposes of this paper, a user experience system is a system that has been strategically developed to optimize the experiences that are important to the user by identifying the user as the focal point of the system in terms of the goals the user is trying to achieve and the environment in which the user is operating.

Figure 1. UX Categorization for NFRs

Therefore, the following are the objectives of this paper:

- Illustrate and categorize the envisioned user experience system.
- Describe the research methodology.
- Objectively analyze the success of a test product and a control product.
- Subjectively analyze a test product and control product against the envisioned user experience system.
- Demonstrate how to perform a Spearman correlation with the pairwise comparison that has been performed herein with a pairwise comparison that, due to the need for brevity, has not been performed herein.
- Provide a high-level description of why this research is important to the Department of Defense (DoD).
- Identify the next steps of this research.

Research Question and Hypothesis

With the problem formulation in mind, the research question is: In product development, are teams more successful when they identify their products as part of a UX system which holistically address NFRs?

Additionally, the hypothesis is: Products that are part of a UX system – which holistically address NFRs – are more successful than products that are not.

Research Objective and Contribution

If it is found that products are more successful when they are designed to be part of an overarching UX system, engineers will be better equipped in the early stages of design – especially when translating stakeholder requirements to system requirements. By generating a

more robust set of requirements through a UX system perspective, there should be less churn due to updating *missed* requirements as the design progresses.

However, while better transitioning from stakeholder to system requirements is significant, the more impactful contribution is demonstrating that success is linked to the degree to which a product is part of a UX system. If it is found that success is linked to the degree to which a product is part of UX system, then it will behoove informed product development teams to holistically consider and embed NFRs into their designs.

Research Methodology

Qualitative Approach

While there are some NFRs which engineers intuitively realize are important and/or attempt to incorporate into designs due to their prevalence (e.g., RAM [reliability, availability, and maintainability]), there is not an overarching approach that facilitates the selection of NFRs needed for product development. In addition, the literature indicates that there is no agreement on a comprehensive and complete list of NFRs.

Hence, a selective literature review has been conducted in which attributes have been gleaned from successful product development efforts which seemingly provide a desirable UX system. Figure 1 illustrates the UX categorization for the NFRs – which are defined below. While this paper is limited in scope, the correlation of the degree to which designers invoke a UX system concept with product success will be attempted by performing pairwise comparisons of competing products. For each pairwise comparison, statistically relevant surveys will be utilized to assess the degree to which a UX system was used. However, with respect to product success, objective metrics will be used; this will be explained in more detail in subsequent sections.

UX Categorization: Acquisition

Acquisition is "the process of obtaining a system, product or service" (ISO/IEC/IEEE, 2017). From this UX categorization and definition, the following NFRs have been identified and defined:

- Affordability – "the degree to which the capability benefits are worth the … total life-cycle cost and support … [the user's] … goals" (Defense Acquisition University [DAU], n.d., para. 1).
- Marketability – "(of products or skills) the quality of being easy to sell because a lot of people want them" (Cambridge Dictionary, n.d., para. 1).
- Obtainability – the ability and ease with which a system or product can be obtained. This includes the removing of items from packaging.

UX Categorization: Initial Use

Here, initial use is defined as the user's first attempt to use the product. Note that, depending on packaging, setup requirements, etc., the end user may be unable to use the product on the first attempt. From this UX categorization and definition, the following NFRs have been identified and defined:

- Compatibility – "1. degree to which a product, system or component can exchange information with other products, systems or components, or perform its required functions, while sharing the same hardware or software environment 2. ability of two or more systems or components to exchange information" (ISO/IEC/IEEE, 2017, p. 79)
- Self-descriptiveness – "1. degree to which a system or component contains enough information to explain its objectives and properties" (ISO/IEC/IEEE, 2017, p. 407)

- Simplicity – "1. degree to which a system or component has a design and implementation that is straightforward and easy to understand" (ISO/IEC/IEEE, 2017, p. 414)

UX Categorization: Utilization

For utilization, it is defined as the act of the end user manipulating the product or system. From this UX categorization and definition, the following NFRs have been identified and defined:

- Operability – "1. degree to which a product or system has attributes that make it easy to operate and control" (ISO/IEC/IEEE, 2017, p. 300)
- Safety – "1. expectation that a system does not, under defined conditions, lead to a state in which human life, health, property, or the environment is endangered" (ISO/IEC/IEEE, 2017, p. 397)
- Usability – "1. extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (ISO/IEC/IEEE, 2017, p. 492)

UX Categorization: Achieving Goals

With respect to achieving goals, it is defined as the ability for the end user to successfully meet a desired objective while or after manipulating the product in the end user's environment. From this UX categorization and definition, the following NFRs have been identified[1] and defined:

- Availability – "1. ability of a service or service component to perform its required function at an agreed instant or over an agreed period of time 2. degree to which a system or component is operational and accessible when required for use" (ISO/IEC/IEEE, 2017, p. 38)
- Interoperability – "1. degree to which two or more systems, products or components can exchange information and use the information that has been exchanged" (ISO/IEC/IEEE, 2017, p. 237)
- Reliability – "1. ability of a system or component to perform its required functions under stated conditions for a specified period of time 2. degree to which a system, product or component performs specified functions under specified conditions for a specified period of time" (ISO/IEC/IEEE, 2017, p. 375)

1.1.1 UX Categorization: Support

Lastly, concerning support, it is defined as the product's ability to "receive services that enable [its] continued operation" (INCOSE, 2015, p. 32).

From this UX categorization and definition, the following NFRs have been identified and defined:

- Maintainability – "1. ease with which a software system or component can be modified to change or add capabilities, correct faults or defects, improve performance or other attributes, or adapt to a changed environment 2. ease with which a hardware system or

[1] "Dependability characteristics include availability and its inherent or external influencing factors, such as availability, reliability (including fault tolerance and recoverability), security (including confidentiality and integrity), maintainability, durability, and maintenance support" (ISO/IEC/IEEE, 2017, p. 375). For the achieving goals UX categorization, it was determined that availability and reliability, in addition to interoperability, would provide better precision than embedding several NFRs into dependability.

component can be retained in, or restored to, a state in which it can perform its required functions" (ISO/IEC/IEEE, 2017, p. 260)
- Serviceability – "Serviceability is the measure of and the set of the features that support the ease and speed of which corrective maintenance and preventive maintenance can be conducted on a system" (Radle & Bradicich, 2019, para. 5).

Use of Case Studies and Surveys

Sampling Strategy

For this effort, two sampling considerations must be made:

1. The number of pairwise comparisons to check for correlation between a UX system and success.
2. The number of participants needed to participate in the surveys which will be used to determine the degree to which a UX system is present in a particular product.

Sample Size of the Comparisons

With respect to the comparisons, the magnitude of correlation between the degree to which a product facilitates a UX system and success is of primary interest. Therefore, to determine the magnitude of correlation, a Spearman correlation will be utilized. The Spearman correlation is subsequently described in more detail, but it should be noted here that the Spearman correlation establishes how well two variables are ranked in comparison to one another for a set of given observations. For example, if two pairwise comparisons are made, then there are four observations which are comprised of two dependent variables and two independent variables. Additionally, if the products that are ranked first through fourth for the degree to which a UX system concept (i.e., the independent variable) was implemented are also ranked first through fourth for product success (i.e., the dependent variable), then there would a perfect Spearman correlation.

$$n = (n_o - b)\left(\frac{\omega_o}{\omega}\right)^2 + b$$

Equation 1. Second-Stage Sample Size Approximation for Spearman Correlation

The sample size needed to utilize the Spearman correlation has been determined based on the process proposed by Douglas Bonett and Thomas Wright (2000) – please see Equation 1. It has been found that $n = 40$, where 40 is rounded up from 39.51. Hence, with $n = 40$, 20 pairwise comparisons are needed. Detailing the process for obtaining the values for each variable in Equation 1 is beyond the scope of this paper but can be provided upon request.

Sample Size of Participants

Participants will be used with the goal of removing bias from the Spearman correlation analysis. Again, the Spearman correlation analysis has been used to investigate the correlation of the UX system and success. Therefore, to remove bias, Likert style scales will be used in which participants provide a numerical score indicating the degree to which the independent variable (i.e., the UX system) is present in a given scenario.

Additionally, while training will be provided to the participants, their training will be based on the author's interpretation of UX systems from both researching the samples and writing the surveys. Indeed, as previously stated, the author has gleaned the concept of UX systems from a selective review of successful and unsuccessful efforts while ensuring that the concept of UX

systems is both rooted in systems engineering and applicable to systems thinking. Hence, the efforts to establish the UX system have necessarily been qualitative.

Thereby, while Likert type scales are quantitative tools, the underlying research is qualitative; hence, for future efforts, qualitative research will be supported by quantitative tools meant to mitigate bias via the use of participants. It has been determined that the number of participants should be the same as the number of comparisons – 40. To arrive at 40 participants, a statistical analysis has been conducted, but the explanation for this analysis is beyond the scope of this paper. Upon request, the methodology for identifying the number of participants can be provided.

Subjective Analysis

Analysis is still underway to determine the best pairwise comparisons from which 20 surveys can be created and sent to participants. Therefore, with respect to the independent variable, one example based on the author's subjective perspective is provided herein to support the contentions made – this pairwise comparison is between Apple's iPod and Microsoft's Zune. Furthermore, the next steps to validate the posited hypothesis will be provided.

However, concerning the dependent variable for the iPod and Zune, data that indicates the degree of commercial success has been compiled from the Securities and Exchange Commission (SEC) and various news reports and journals. Hence, the data pertaining to the dependent variable is objective.

With respect to the independent variable (i.e., the degree to which a UX system has been produced), a Likert style scale is used and the scoring is based upon the NFRs which have been previously defined. Therefore, for each NFR within a category, a Likert score will be obtained from zero to four; please see Table 1. Thereby, for each category, the maximum score possible is four multiplied by the number of NFRs within a particular category; the number of NFRs within the categories vary. Lastly, to obtain the overall score, the scores from each category will be summed.

Table 1. NFR Scoring

Classification	Points
Strongly disagree	0
Disagree	1
Neutral	2
Agree	3
Strongly agree	4

iPod vs. Zune

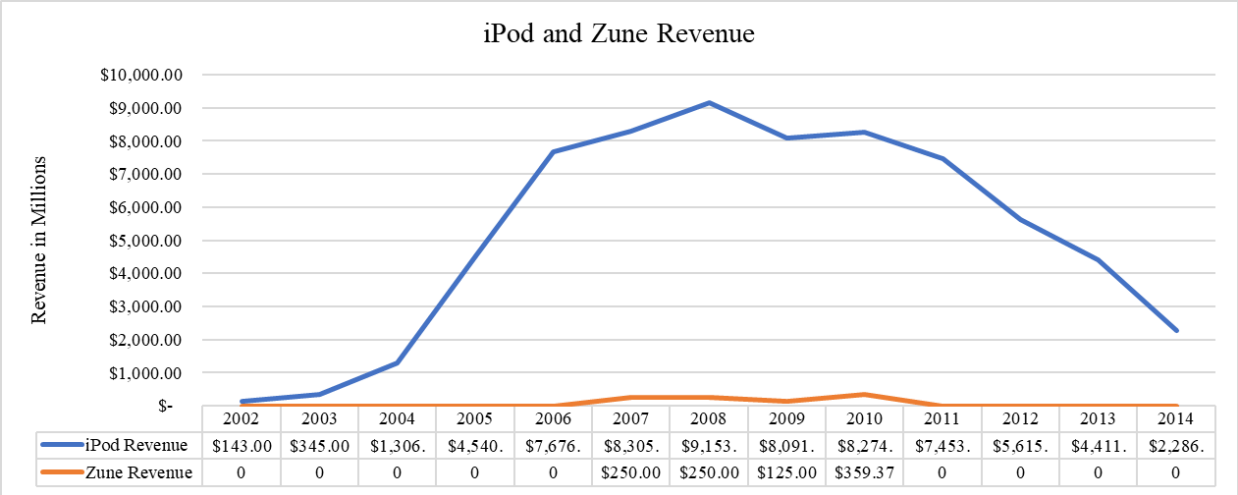
Dependent Variable

Graph 1 contains the revenue for both the iPod and the Zune. To convert the information from Graph 1 into one score for the iPod and one score for the Zune, an experimental global scale has been identified for use. "An experimental global scale is based upon an individual's personal experience with or knowledge of a particular subject" (Monat, 2009, p. 498).

$$y = y_1 + (x - x_1) * \frac{(y_2 - y_1)}{(x_2 - x_1)}$$

Equation 2. Linear Interpolation

When the revenues for the iPod and Zune are summed from Graph 1, the iPod's total revenue is approximately $67.6 billion, while the Zune's total revenue is approximately $984 million. Therefore, based on this knowledge coupled with the previously defined experimental global scale in mind, $70 billion in revenue is identified as the best value and will be awarded a score of 10, while $500 million in revenue is identified as the worst value and will be awarded a score of zero. Hence, when these figures are placed into Equation 2, where the x-values are in dollars and the y-values are success scores, the iPod receives a success score of approximately 9.65, while the Zune receives a success score of approximately 0.07.



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
iPod Revenue	$143.00	$345.00	$1,306.	$4,540.	$7,676.	$8,305.	$9,153.	$8,091.	$8,274.	$7,453.	$5,615.	$4,411.	$2,286.
Zune Revenue	0	0	0	0	0	$250.00	$250.00	$125.00	$359.37	0	0	0	0

Graph 1. iPod[2] and Zune[3] Revenue

[2] For the years listed, iPod revenue was obtained via the pertinent 10-K filings with the Securities and Exchange Commission listed in the references herein.

[3] Desjardins (2007) reports that Zune hits one million sales. Miller (2008) reports that Zune hits two million total sales. Microsoft's 10-Q filings for December with the Securities and Exchange Commission states, "Zune platform revenue decreased $100 million or 54% reflecting a decrease in device sales" (Microsoft Corporation, 2008, p. 31). The information from the 10-Q filing was used to extrapolate for the 2009 value. Letzing (2009) reported, "More recent data from NPD Group Inc. indicates that the Zune's already slim market share may have slipped further. NPD Group analyst Ross Rubin said in the first half of this year, Zune's share was 2%, compared to about 70% for the iPod." The iPod sold 50,312,000; this implies that the total market sold approximately 71,874,285. Therefore, for the 2010 value, it is approximated that the Zune sold 1,437,485. The cost of the Zune is assumed to be $250 throughout 2007–2010.

iPod Independent Variable

While the iPod Touch can still be purchased, the primary lifecycle of the iPod spanned from 2002–2014, with its peak years occurring during the short lifespan of the Zune, 2007–2010; please reference Graph 1. Therefore, for this comparison with the Zune, the fifth generation iPod Nano (16 GB), which overlapped with the lifespan of the Zune and with the iPod's peak years, will be used for this comparison – please reference Image 1 (Everyi.com, n.d.).

Image 1. iPod Nano (Fifth Generation)

Acquisition

Affordability

To reiterate, this is a subjective analysis based on the author's perspective. In future research, statistically relevant surveys will determine the score for each NFR using the Likert style scale in Table 1. Also, please note that all of the subsequent ratings utilize the Likert style scale in Table 1. Therefore, with respect to the affordability analysis, the initial retail price of the fifth generation iPod Nano was $179 (Everyi.com, n.d.). Hence, with the Zune selling for $249.99, an agree rating of three for affordability is identified.

Marketability

Between the years under consideration, 2007–2010, revenue for Apple from their full suite of iPods was $33,805,000,000; therefore, with respect to marketability, a strongly agree rating of four is identified.

Obtainability

There are no known supply chain issues for the nine different colorful versions of the iPod Nano. Therefore, when contrasted with the Zune which had limited production runs of a smaller subset of colors, the ability and ease with which a user can obtain a particular color is much greater with the iPod than the Zune.

Additionally, from observing an unpackaging video[4] of the iPod Nano, the iPod is well-protected against being damaged during transit. Also, the iPod can easily be removed from its casing by simply removing tape. Furthermore, once the case is open, the contents, with necessary paperwork, can be easily deposited into the user's hand. Hence, with respect to obtainability, a strongly agree rating of four is identified.

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[4] A YouTuber, DetroitBORG (2009), provides a video detailing the "iPod Nano 5th Generation Unboxing" experience. The URL for this video can be found in the reference section.

Total: iPod Acquisition

The total iPod score for Acquisition is 11.

Initial Use

Compatibility

From an interview with *Time*, Steve Jobs stated, "We're the only company that owns the whole widget – the hardware, the software, and operating system … We can take full responsibility for the user experience" (Isaacson, 2011, p. 381). Via the iTunes Store, on either a macOS or a Windows operating system, the iPod works seamlessly between the hardware and software environment – please reference Image 2 (Dudovskiy, 2021). Indeed, when a new iPod is plugged into a computer with iTunes open, iTunes recognizes the new iPod and launches the iPod setup assistant[5] – see Image 3 (Apple Inc., 2009b, p. 24). Thereby, with respect to compatibility, a strongly agree rating of four is identified.

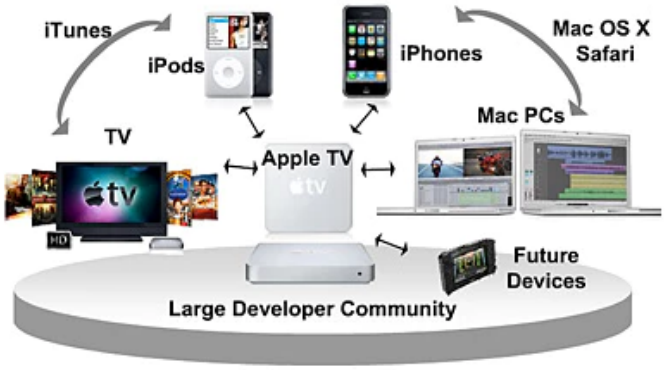

Image 2. Apple Ecosystem

Self-Descriptiveness

As seen in Image 1, the click wheel is used as the primary human machine interface (HMI). When the iPod is turned on, the user can scroll between music, videos, podcasts, etc. using the click wheel. Additionally, at the bottom of the main screen, there is a small preview panel[6] which provides a visual of the selected option (e.g., if music is selected, the album covers of the songs contained within the iPod are shown). Furthermore, with the click wheel, it is very intuitive for the user to navigate to the desired functions – see Image 4 (Apple Inc., 2009b, p. 14). Thereby, for self-descriptiveness, a strongly agree rating of four is identified.

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[5] Fordummies (2009) has a generic video detailing the iPod setup process. The URL for this video can be found in the reference section.

[6] A YouTuber, Orangey456 (2015), provides a video which illustrates the preview pane and the ease with which the click wheel facilitates HMI. The URL for this video can be found in the reference section.

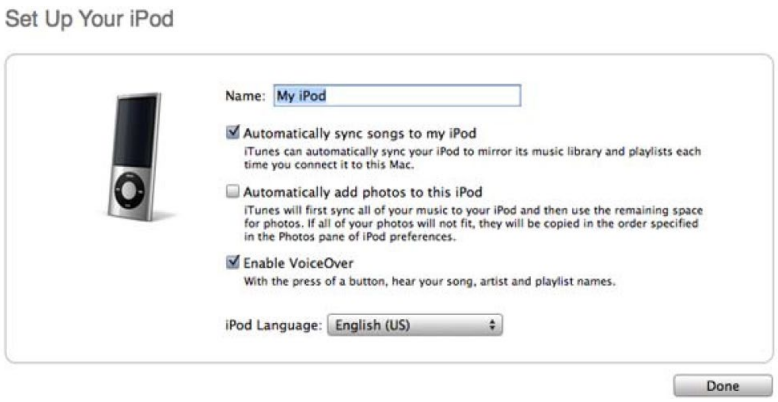

Image 3.: iTunes Setup Assistant

Simplicity

Apple realized early on that the iPod could be designed "in tandem with the iTunes software, allowing it to be simpler" (Isaacson, 2011, p. 384). Additionally, "by [Apple] owning the iTunes software and the iPod device, that allowed [Apple] to make the computer and the device work together, and it allowed [Apple] to put complexity in the right place" (Isaacson, 2011, p. 389). Hence, complexity is placed in the iTunes software (e.g., the iTunes Setup Assistant) which the computer processes, enabling the iPod to be simpler.

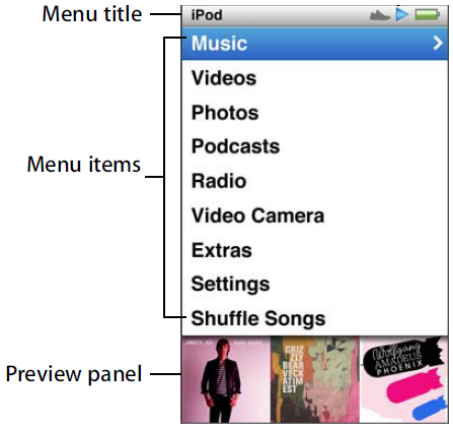

Image 4. Preview Panel with Functions

Therefore, with the integration of the iTunes software coupled with the intuitive nature of the way in which the click wheel can be used to scroll various menus, a strongly agree rating of four is identified for simplicity.

Total: iPod Initial Use

The total iPod score for Initial Use is 12.

Utilization

Operability

The degree to which the iPod can be easily operated and controlled are linked to its attributes, which includes its controls. Image 5 (Apple Inc., 2009b, p. 4) and Image 6 (Apple Inc., 2009b, p. 4) illustrate the iPod's controls and attributes.

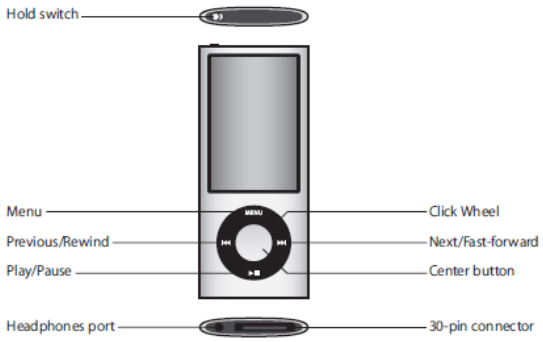

Image 5. iPod (Front View)

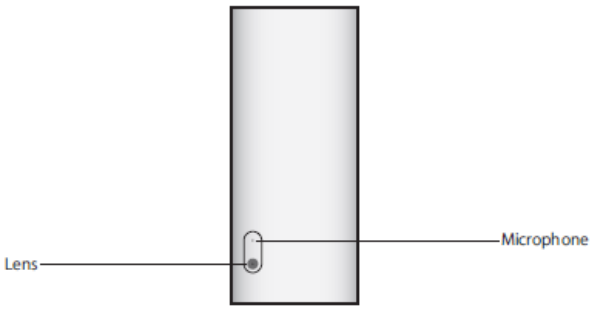

Image 6. iPod (Rear View)

As seen in Image 5, the click wheel provides the means through which the user primarily operates the iPod. As previously discussed, the click wheel provides the ability to scroll; however, it also provides intuitive “play/pause,” “previous/rewind,” and “next/fast-forward” functions. Hence, with the ease in which an iPod can be controlled in one hand, a strongly agree rating of four is identified for operability.

Safety

With respect to safety, the primary use of the iPod is listening to media (e.g., music, podcasts, audiobooks, etc.). Therefore, the volume on the iPod could create conditions in which the iPod is unsafe. Hence, the iPod has the ability to select a maximum volume limit. More impressively, the iPod has the ability to require a combination to change the maximum volume – which could be critical in the event a parent and/or caregiver is concerned about the judgement of the end user (Apple Inc., 2009b, p. 45). Thereby, under defined conditions, the system can help prevent endangerment. Unfortunately, there have been reports of the iPod batteries – from various models – catching fire (Marsal, 2009). However, from 2007–2009, there were approximately 160,590,000 iPods sold (Apple Inc., 2009a, p. 10). Therefore, due to the quantity of iPod sales coupled with the seemingly scarcity of incidents, the Consumer Product Safety Commission determined the risk to safety as “very low” (Marsal, 2009, para. 4). Thereby, with respect to safety, an agree rating of three is identified.

Usability

For the iPod, Jobs demanded that the user should be able to get to any song or function in three clicks or less – from any screen (Isaacson, 2011, p. 388). Therefore, in three clicks or less, the user can: listen to downloaded music, watch videos, record videos, listen to FM radio, record audio memos, etc. Hence, the user’s goals with the iPod can be effectively and efficiently satisfied. Thereby, with respect to usability, a strongly agree rating of four is identified.

Total: iPod Utilization

The total iPod score for Utilization is eleven.

Achieving Goals

Availability

With respect to the iPod, mean time between failure (MTBF) and mean time to repair (MTTR) data cannot be found, and, with the exception of damage or an unusual defect, it is assumed that the iPod will be replaced by obsolescence and not due to failure. Hence, from the user's day-to-day perspective, the battery is key to availability. Therefore, with a fully charged battery, music playback is 24 hours and video playback is five hours (Apple Inc., n.d.a). Also, the battery will charge to 80% in one and a half hours and fully charge in three hours (Apple Inc., 2009b, p. 16). Thereby, with respect to availability, a strongly agree rating of four is identified.

Interoperability

"The iPod and iTunes created an ecosystem of music which included the simple purchase, organization, and portable playback that previously took several steps and suppliers to achieve" (Empringham, 2013, para. 1).

Therefore, a user's goal of listening to music became easier and more streamlined with the iPod and the interoperability of products within the Apple Ecosystem. Hence, the streamlining in Image 7 (Empringham, 2013) is made possible by the ecosystem depicted in Image 2. Thereby, with respect to interoperability, a strongly agree rating of four is identified.

Image 7. Streamlined iTunes and iPod Ecosystem

Reliability

As with availability, it is assumed that, with the exception of damage or an unusual defect, the iPod will be replaced by obsolescence and not due to failure. Again, with respect to the iPod, MTBF and MTTR data cannot be found. Hence, from the user's perspective, the battery is key to reliability – the battery has a limited number of charging cycles.

Links to information pertaining to the iPod Nano's battery Apple no longer appear to be active. Therefore, since Apple uses a lithium-ion battery for both the iPhone and the iPod, it is assumed here that the iPod's battery will behave similarly to the iPhone which "is designed to retain up to 80% of its original capacity at 500 complete charge cycles when operating under normal conditions" (Apple Inc., n.d.b). Also, the iPod has a built-in energy saver which helps decrease the rate of battery consumption (Apple Inc., 2009b, p. 18). Thereby, with respect to reliability, a strongly agree rating of four is identified.

Total: iPod Achieving Goals

The total iPod score for Achieving Goals is 12.

Support

Maintainability

With respect to the iPod, it has been previously discussed that complexity resides in iTunes on a computer in lieu of the iPod itself. Therefore, by having the most up-to-date iTunes software installed on a computer with which the iPod is synchronized, software maintenance is simple. Concerning hardware maintainability, the iPod can be easily damaged (especially the glass display) when dropped and when liquid (e.g., sweat, etc.) gets inside the casing. However, there are a plethora of cases which can be placed around the iPod which drastically minimizes the impact of getting wet (see Image 8; Amazon.com, Inc., n.d.a) and/or being dropped (see Image 9; Amazon.com, Inc., n.d.b). Thereby, with respect to maintainability, a strongly agree rating of four is identified.

Image 8. iPod Nano Armband

Serviceability

Most problems can be solved quickly by the user following "the five Rs" which is to: 1) reset the iPod, 2) retry connecting the iPod with a different USB port, 3) restart the computer and ensure the computer has the latest iTunes software, 4) reinstall the latest iTunes software, and 5) restore the iPod with the most up-to-date iTunes software (Apple Inc., 2009b, pp. 86–92).

Image 9. iPod Nano Silicone Case

As discussed during reliability, the battery will have a limited number of charging cycles; therefore, it is the most likely item needing service. Unfortunately, for the fifth generation iPod Nano, expert battery installation is required – please see Image 10 (iPodBatteryDepot, n.d.). Fortunately, Apple has extensive support services via their Genius Bar (Apple Inc., n.d.c), and the user will be charged for support based on warranty coverage (Apple Inc., n.d.d). Thereby, with respect to serviceability, an agree rating of three is identified.

Total: iPod Support

The total iPod score for Support is seven.

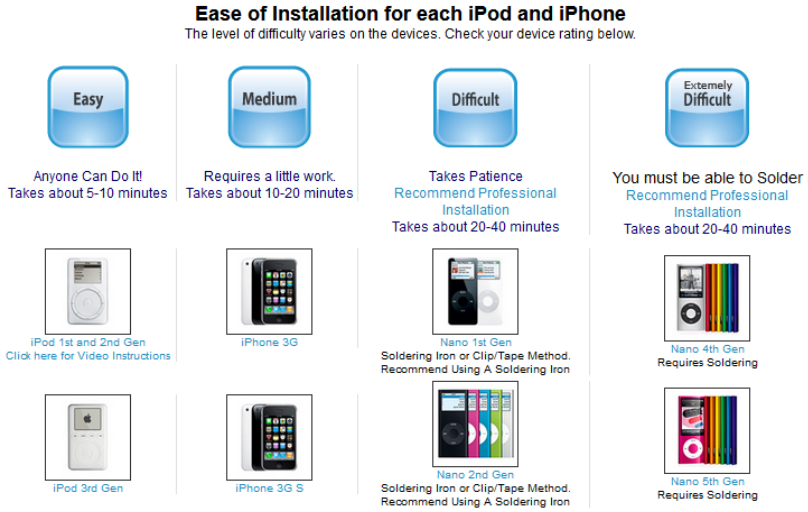

Image 10. Ease of Battery Installation for Each iPod and iPhone (Abridged)

Zune Independent Variable

Per Graph 1, the Zune generated revenue from 2007 to 2011. Additionally, Microsoft launched the Zune when iPod sales were at their peak. Therefore, for this comparison, the UX system of the initial Zune (Zune 30) offering is evaluated – please reference Image 11 (Stars and Décor Co., n.d.).

Image 11. Zune 30

Acquisition

Affordability

The initial retail price of the Zune was $249.99 (Montalbano, 2006, para. 1). Therefore, with the iPod selling at $179, a neutral rating of two for affordability is identified.

Marketability

With Apple dominating the portable media player (PMP) market in 2006 with a total revenue of $7,676,000,000 (Apple Inc., 2006, p. 54) and having a four-year head start in building up a customer base, it is difficult to envision a scenario in which the Zune would be

easy to sell to anyone other than people who do not like the Apple brand and/or people who are technology enthusiasts. Hence, a strongly disagree rating of zero is identified for marketability.

Obtainability

No major supply chain concerns can be found for the Zune itself; however, there were several limited editions. For example, only 100,000 pink Zunes were produced (Quilty-Harper, 2007, para. 1). Initially, when a customer ordered a Zune, the customer had to pick between black, brown, or white. However, during the initial offerings of new and oftentimes limited-edition colors of the Zune, Microsoft randomly sent Zunes which were not black, brown, or white to customers. For example, had someone ordered one of the original colors of black, brown, or white, they might have been sent an orange Zune (Oiaga, 2006).

Additionally, from observing an unpackaging video[7] of the Zune 30 performed recently by a collector, the Zune is well-protected against being damaged during transit; however, it requires a boxcutter to efficiently unpackage the Zune. Also, various items appear to be hidden away at first glance – making them susceptible to be unseen and thrown out.

Due to these concerns, a disagree rating of one for obtainability is identified.

Total: Zune Acquisition

The total Zune score for Acquisition is three.

Initial Use

Compatibility

To initially use[8] the Zune, it must first be plugged into a Windows based operating system (OS); and, with the Zune plugged in, the installation compact disc (CD) must be inserted into the computer with an internet connection. An internet connection is needed to ensure the installation software obtains any required updates. Once the installation software has completed its tasking and the Zune is fully charged, the computer will prompt the user that the Zune is ready to be energized. Furthermore, the Zune itself may require updates – which, if needed, will begin shortly after being energized.

Hence, a disagree rating of one is identified for the Zune's compatibility due to the following: 1) the need for a CD, 2) the requirement of a Windows based OS, 3) the potential for updates on both the computer software and Zune itself, and 4) the need to wait for the computer to prompt the user to energize the Zune.

Self-Descriptiveness

Similar to the iPod, the Zune has a click wheel which allows the user to navigate between functions. In addition, per Image 11, the functions are clearly labeled. However, the Zune does not have a small preview panel – like the iPod. The Zune's albums category does provide similar information to the iPod, but not as a preview – please see Image 12 (Block, 2006). Therefore, an agree rating of three for self-descriptiveness is identified.

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[7] A YouTuber, Lowkey Bre (2021), provides a video detailing the "Zune unboxing" experience. The URL for this video can be found in the reference section.

[8] The YouTube channel Gadgets and Gears (2011), which is a child channel to the YouTube Videojug channel, provides a video detailing the initial Zune installation and charging. This video is the basis for this section. The URL for this video can be found in the reference section.

Image 12. Albums Category

Simplicity

As previously mentioned,[9] a CD and a Windows based computer – which is connected to the internet – is needed to initially use the Zune. Additionally, the user is advised to not energize the Zune until prompted by the installation software; and, after being energized, the Zune itself may require updates before its initial use.

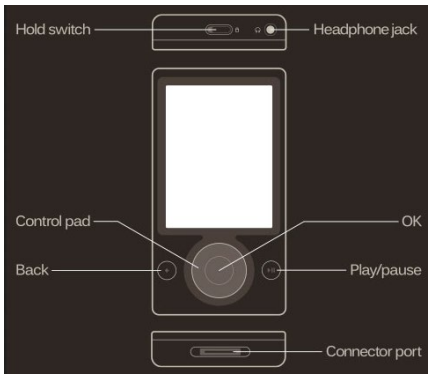


Image 13. Zune's Controls

Due to the number of specific instructions and the need for a CD, a disagree rating of one for simplicity is identified.

Total: Zune Initial Use

The total Zune score for Initial Use is five.

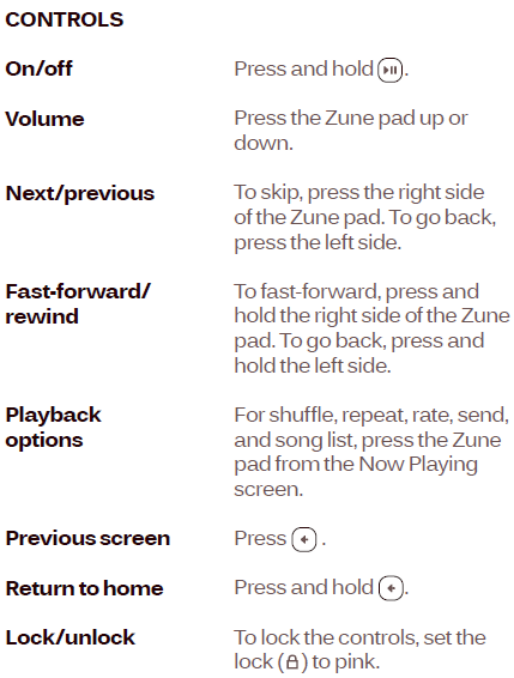
Utilization

Operability

The ease with which the Zune can be operated is linked to its controls – as seen in Image 13 (Amazon.com, Inc., n.d.c). Also, the controls for the Zune can be manipulated to obtain different outcomes – please see Image 14 (Microsoft Corporation, n.d.). For example, the

[9] The YouTube Channel Gadgets and Gears (2011), which is a child channel to the YouTube Videojug channel, provides a video detailing the initial Zune installation and charging. The URL for this video can be found in the reference section.

back arrow can either allow the user to return to the previous screen or return to the home screen – depending on the duration that the button is held.



CONTROLS	
On/off	Press and hold ⏯.
Volume	Press the Zune pad up or down.
Next/previous	To skip, press the right side of the Zune pad. To go back, press the left side.
Fast-forward/ rewind	To fast-forward, press and hold the right side of the Zune pad. To go back, press and hold the left side.
Playback options	For shuffle, repeat, rate, send, and song list, press the Zune pad from the Now Playing screen.
Previous screen	Press ←.
Return to home	Press and hold ←.
Lock/unlock	To lock the controls, set the lock (🔒) to pink.

Image 14. Zune Controls

While the buttons appear to be simple and in an intuitive location, utilizing the multiuse buttons does not appear to be immediately intuitive; therefore, it seems that this may – at least initially – impede the ease with which the Zune can be operated. Hence, a neutral rating of two for operability is identified.

Safety

Similar to the iPod, the Zune's primary use is listening to and watching media (e.g., music, videos, audiobooks, etc.). Unlike the iPod, however, the Zune does not appear to have the ability to set a maximum audio limit – which can be critical in the event that a parent and/or caregiver is concerned about the judgement of the end user.

Additionally, while there were limited production runs, no major safety concerns – pertaining to the Zune or any of its components – can be found. Hence, a neutral rating of two for safety is identified.

Usability

Image 11 illustrates the six main areas available, and Image 12 illustrates the twist interface. As shown in Image 12, the twist interface facilitates quick access (Block, 2006, para. 10) to some of the contents of the six main areas by enabling both horizontal and vertical scrolling. While the twist interface allows the user to quickly navigate, it is operated by the control pad and seems to require a learning curve for a user to become adept at knowing what control pad manipulation operates which portion of the twist interface. Hence, an agree rating of three for usability is identified.

Total: Zune Utilization

The total Zune score for Utilization is seven.

Achieving Goals

Availability

Similar to the iPod, the Zune's MTBF and MTTR data cannot be found. In addition, as with the iPod, it is assumed that the Zune – with the exception of damage or an unusual defect – will be primarily replaced by obsolescence and not due to failure. Therefore, from a user's perspective, the battery is key to availability. Hence, with a fully charged battery, music playback is fourteen hours (Kim, 2006, para. 1) and video playback is four hours (Kim, 2006, para. 2). Furthermore, upon complete draining, the battery will fully charge in approximately three hours (King, n.d., para. 2).

Dissimilar to the iPod, all Zune 30s suffered a major outage – just as Microsoft was trying to capture market share in the PMP market. Due to the leap year in 2008, all Zunes froze on the last day of the year because they were programmed to have 365 days in lieu of 366 days. To get the Zunes to function, Microsoft advised users to allow the Zune's battery to fully drain and reenergize the devices on January 1, 2009 (Wortham, 2008).

Due to the leap year issue and a suboptimal battery when compared to the iPod, a disagree rating of one for availability is identified.

Interoperability

Similar to the way in which the iTunes Store and the iPod operated, the Zune had its own way to purchase music and other media content via the Zune Marketplace – the Zune Marketplace is no longer operational. Additionally, with the Zune Music Pass, Microsoft provided subscribers with unlimited access to the entire catalog on the Zune Marketplace. Whereas the iTunes Store also provided the primary software functions for the iPod, the Zune Marketplace and the Zune software – which is found on the installation CD – are separate. Hence, there was a series of installation steps (as previously discussed) which needed to occur before the Zune could access the Zune Marketplace. Thereby, with respect to interoperability, a neutral rating of two is identified.

Reliability

From a user's perspective, it is assumed that the battery is key to reliability. As previously stated, it is likely that the Zune will be replaced by obsolescence and not due to failure; unfortunately, there is neither MTBF nor MTTR data to verify this assumption against.

Image 15. Zune Enclosed Within a ToughSkin Case

While test data pertaining to the Zune's battery cannot be found, it is known that the battery is a lithium-ion, 3.7 volts (IFIXIT, n.d.b, para. 5). For this type of lithium-ion battery, it has

been assumed that the expected life cycle is greater than 500[10] which is similar to the assumptions made about the iPod. However, unlike the iPod, the Zune does not have a built-in energy saver to help decrease battery consumption. Thereby, with respect to reliability, an agree rating of three is identified.

Total: Zune Achieving Goals

The total Zune score for Achieving Goals is six.

Support

Maintainability

While software support for the Zune is no longer available, the Zune did allow for automatic updates. To facilitate automatic updates, the Zune needed to be connected to a computer with the Zune software running – the software was designed to automatically look for new versions (IFIXIT, n.d.a, para. 5). With respect to hardware maintainability, the Zune had several case options available which could minimize the impact of being dropped or getting wet. For example, Speck made a ToughSkin case for the Zune. The ToughSkin case was highly ruggedized – please see Image 15 (Amazon.com, Inc., n.d.d).

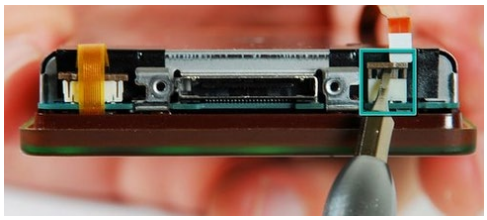


Image 16: Zune Battery Release

Due to the limited production run of the Zune which ultimately caused the ceasing of software support, it is obvious that long-term maintainability for the end user is, at best, difficult. However, if the Zune would have had greater success, leading to the production of more Zunes, it is clear that the Zune was well-positioned to provide maintainability. Thereby, due to the impact that limited production of the Zune had on maintainability, a neutral rating of two is identified.

Serviceability

Regarding the ease and speed with which corrective action can be taken on the Zune, nothing can be found in the official Zune literature describing how most problems can be resolved. It was previously conveyed that the battery is key to reliability; therefore, the battery is likely to be the primary item within the Zune needing service. Due to the way in which the battery is internally attached and the tools needed to extract the battery, replacing the battery is beyond the scope of what most users will be able to accomplish and will likely require an expert technician – please see Image 16 (IFIXIT, n.d.b) which illustrates the release of the battery ribbon and Image 17 (IFIXIT, n.d.b) which depicts the battery removed from the Zune.

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[10] "Lithium Polymer Ion batteries provide the performance of the Li-ion in a thin or moldable package" (HiMAX, n.d., para. 1). "Expected cycle life is about 500+ cycles" (HiMAX, n.d., para. 3).

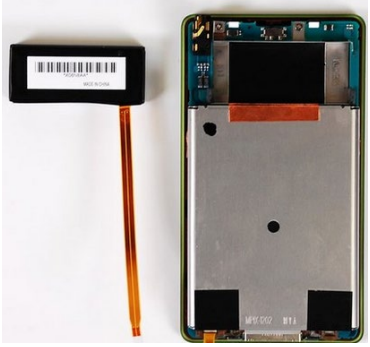

Image 17. Zune Battery Removed

Even before the Zune was discontinued, there was nothing similar to the Genius Bar that Apple provides. Hence, if the user was able to obtain service via a warranty, the user would be required to package and mail the Zune. Furthermore, as Microsoft was phasing out the Zune, they abruptly cancelled their extended warranty program (Hunting, 2011). Thereby, with respect to serviceability, a strongly disagree rating of zero is identified.

Total: Zune Support

The total Zune score for Support is two.

Independent Variable Summary: iPod and Zune

Table 2. Independent Variable Summary of the iPod and Zune

Product	Acquisition	Initial Use	Utilization	Achieving Goals	Support	Total
iPod	11	12	11	12	7	53
Zune	3	5	7	6	2	23

Subjective Spearman Correlation Example

To illustrate how the hypothesis stated herein – which asserts that product development teams are more successful when they identify their products as part of a UX system by holistically addressing NFRs – will ultimately be tested, two pairwise comparisons will be used. However, for the sake of brevity, the analysis of the independent variable and dependent variable for another pairwise comparison will not be performed herein.

$$r_s = 1 - \frac{6\sum_i d_i^2}{n(n^2-1)}$$

Equation 3. Spearman Correlation Equation

The Spearman Correlation Equation can be found in Equation 3, where "r_s" is bounded between negative one and one. The closer "r_s" is to one, the more positive the correlation – this would confirm the author's hypothesis. However, the closer "r_s" is to negative one, the more negative the correlation. If "r_s" equals zero, there is no discernable correlation.

In Equation 3, "n" is the number of each observation (i.e., twice the number of pairwise comparisons) and "d" is equal to the distance between the success (i.e., the dependent variable) score rank and the UX (i.e., the independent variable) score rank – each observation will have its dependent and independent variable ranked. After the ranking is performed, "d" will be squared for each observation and the sum of "d^2" will be tallied. With the results from the previously performed iPod and Zune analysis, this is illustrated in Table 3 with an additional

pairwise comparison of the iPhone and BlackBerry which, as previously stated, is not conducted herein for the sake of brevity.

Table 3. Validation Example

-	UX Score	Success (Global) Score	UX Score (rank)	Success Score (rank)	d	d^2
iPod	53	9.65	2	2	0	0
Zune	23	0.07	3	4	-1	1
iPhone	55	9.85	1	1	0	0
BlackBerry	20	0.65	4	3	1	1
$\sum_i d_i^2$	-	-	-	-	-	2

When the results from Table 3 are placed into Equation 3, the results are Calculation 1 which demonstrates a positive Spearman Correlation of 0.8 (i.e., the more that a product holistically addresses NFRs which emphasize a UX system, the more successful the product will be).

$$r_s = 1 - \frac{(6)(2)}{4(4^2 - 1)} = 0.8$$

Calculation 1. Spearman Correlation Calculation

Potential Importance to the DoD and Next Steps

DoD Importance

The current level of hostility around the globe has not been experienced in over 70 years. Additionally, while threats are seemingly increasing, funding to the DoD is decreasing – primarily due to increased fuel costs and inflation.

> President Biden's $715 billion FY22 budget for the Department of Defense … assumed 2.2% inflation and a 10.1% increase in fuel costs. With inflation … closer to 7% and with fuel costs for the world's largest purchaser of fuel up 30%, DoD faces a $40 billion second half hole in its FY22 budget. For perspective, the FY13 Budget Control Act (BCA) DoD sequester totaled $37.2 billion. (Taylor & Goss, 2022, para. 1)

Therefore, now is the time for engineering ingenuity within the DoD by thinking in terms of the warfighters' experiences and building systems which efficiently maximize those experiences. For example:

- Placing cost in the forefront, how efficiently can a system – with the attributes important to the warfighter – be acquired?
- Pertaining to training, how can the learning curve needed to operate a warfighting system be minimized without compromising effectiveness?
- When the warfighter is under extreme pressure, how can it be ensured that a warfighting system operates in a usable and safe manner?
- With the number of interconnected systems within the DoD, how can it be ensured that a given system will be available to reliably interoperate with other systems to achieve the warfighter's goals?
- Concerning return on investment, how can warfighting systems achieve longevity via proper support?

These are just few questions[11] which are believed to be natural extensions of this research.

Next Steps

The immediate next steps in this research are to: 1) fully identify the statistically relevant set of commercial pairwise comparisons, 2) create a survey to determine the degree to which a UX system has been implemented in each observation, 3) obtain objective success data for each observation, 4) provide the surveys to current graduate students enrolled in a systems thinking class, and 5) evaluate the survey effectiveness.

Regarding the intermediate steps of this research, the following is planned: 1) the surveys will be modified based on any lessons learned from the initial surveys which will solely be sent to graduate students enrolled in a systems thinking class, 2) the surveys will be sent to the statistically relevant set of participants, 3) the data will be processed and conclusions will be made, and 4) a dissertation will be completed.

In the long-term, if it is ultimately found that commercial products which are part of a UX system – as described herein – correlate to success, then translating this insight into DoD applicability will be an emphasis of future research.

References

Amazon.com, Inc. (n.d.a). *Tune belt armband for iPod nano 4th and 5th generation - for use with or without Nike+ receiver*. Retrieved February 27, 2022, from https://www.amazon.com/Armband-Compatible-iPod-nano-generation/dp/B002RX7RN6

Amazon.com, Inc. (n.d.b). *Silicone case for iPod nano 5th generation, clear, replacement part from complete TuneBand package, silicone CASE ONLY*. Retrieved February 27, 2022, from https://www.amazon.com/Silicone-Generation-Replacement-Complete-TuneBand/dp/B01H4EVI4Q

Amazon.com, Inc. (n.d.c). *Zune 30 GB digital media player (pink)*. Retrieved March 19, 2022, from https://www.amazon.com/Zune-Digital-Media-Player-Pink/dp/B000OK0CIQ

Amazon.com, Inc. (n.d.d). *Speck ToughSkin case for Zune 30 GB (black)*. Retrieved March 19, 2022, from https://www.amazon.com/dp/B000JLU1JU

Apple Inc. (2003). *Form 10-K*. Securities and Exchange Commission. https://www.sec.gov/Archives/edgar/data/320193/000104746903041604/a2124888z10-k.htm

Apple Inc. (2004). *Form 10-K*. Securities and Exchange Commission. https://www.sec.gov/Archives/edgar/data/320193/000104746904035975/a2147337z10-k.htm

Apple Inc. (2005). *Form 10-K*. Securities and Exchange Commission. https://www.sec.gov/Archives/edgar/data/320193/000110465905058421/a05-20674_110k.htm

Apple Inc. (2006). *Form 10-K*. Securities and Exchange Commission. https://www.sec.gov/Archives/edgar/data/320193/000110465906084288/a06-25759_210k.htm

Apple Inc. (2007). *Form 10-K*. Securities and Exchange Commission https://www.sec.gov/Archives/edgar/data/320193/000104746907009340/a2181030z10-k.htm

Apple Inc. (2008). *Form 10-K*. Securities and Exchange Commission. https://www.sec.gov/Archives/edgar/data/320193/000119312508224958/d10k.htm

Apple Inc. (2009a). *Form 10-K*. Securities and Exchange Commission. https://www.sec.gov/Archives/edgar/data/320193/000119312510012091/d10ka.htm

Apple Inc. (2009b). *iPod nano user guide*. https://www.manualsdir.com/manuals/546997/apple-ipod-nano-5th-generation.html?download

[11] It is understood and appreciated that a lot of great work is currently underway to address these questions. It is respectfully suggested that holistically addressing these questions from the perspective of Figure 1 could be beneficial.

Apple Inc. (2010). *Form 10-K*. Securities and Exchange Commission. https://www.sec.gov/Archives/edgar/data/320193/000119312510238044/d10k.htm
Apple Inc. (2011). *Form 10-K*. Securities and Exchange Commission. https://www.sec.gov/Archives/edgar/data/320193/000119312511282113/d220209d10k.htm
Apple Inc. (2012). *Form 10-K*. Securities and Exchange Commission. https://www.sec.gov/Archives/edgar/data/320193/000119312512444068/d411355d10k.htm
Apple Inc. (2013). *Form 10-K*. Securities and Exchange Commission. https://www.sec.gov/Archives/edgar/data/320193/000119312513416534/d590790d10k.htm
Apple Inc. (2014). *Form 10-K*. Securities and Exchange Commission. https://www.sec.gov/Archives/edgar/data/320193/000119312514383437/d783162d10k.htm
Apple Inc. (n.d.a). *iPod nano (5th generation) - technical specifications*. https://support.apple.com/kb/sp569?locale=en_US
Apple Inc. (n.d.b). *iPhone battery and performance*. https://support.apple.com/en-us/HT208387
Apple Inc. (n.d.c). *For getting the right support, here's a genius idea*. https://www.apple.com/retail/geniusbar/
Apple Inc. (n.d.d). *iPod service and repair*. https://support.apple.com/ipod/repair/service
Block, R. (2006). *Zune review*. engadget. https://www.engadget.com/2006-11-15-zune-review.html
Bonett, D. G., & Wright, T. A. (2000). Sample size requirements for estimating Pearson, Kendall and Spearman correlations. *Psychometrika*, *65*(1), 23–28.
Cambridge Dictionary. (n.d.). *Marketability*. Cambridge University Press. Retrieved February 19, 2022, from https://dictionary.cambridge.org/us/dictionary/english/marketability
Defense Acquisition University. (n.d.). *Affordability – SE trade-off analyses*. https://www.dau.edu/tools/se-brainbook/Pages/Design%20Considerations/Affordability.aspx
Desjardins, D. (2007). Zune sales hit 1 million; has ways to catch up. *Retailing Today*, *46*(10), 19.
DetroitBORG. (2009, September 13). *iPod nano 5th generation unboxing* [Video]. YouTube. https://www.youtube.com/watch?v=I6r_nP8UR28
Dudovskiy, J. (2021). *Apple ecosystem: Closed and effective*. Business Research Methodology. https://research-methodology.net/apple-ecosystem-closed-effective/
Empringham, T. (2013). *Connecting the value chain*. SucceedSooner. https://succeedsooner.ca/2013/04/08/connecting-the-value-chain/
Everyi.com. (n.d.). *Apple iPod nano 5th gen/camera 8 GB, 16 GB specs*. https://everymac.com/systems/apple/ipod/specs/ipod-5th-generation-5g-nano-specs.html
fordummies. (2009, February 25). *How to set up your iPod for dummies* [Video]. YouTube. https://www.youtube.com/watch?v=60E4WV1efYg
Gadgets and Gears. (2011, April 6). *A guide to installing and charge your Zune* [Video]. YouTube. https://www.youtube.com/watch?v=Daa3cgwLxBQ
HiMAX. (n.d.). *Li polymer 3.7V 800mAh battery*. https://himaxelectronics.com/product-item/li-polymer-3-7v-800mah-battery/
Hunting, B. (2011). *Microsoft ends extended warranty coverage for the Zune*. https://benjaminhunting.com/2011/01/microsoft-ends-extended-warranty-coverage-for-the-zune/
IFIXIT. (n.d.a). *Microsoft Zune 30 troubleshooting*. https://www.ifixit.com/Wiki/Microsoft_Zune_30
IFIXIT. (n.d.b). *Microsoft Zune 30 GB battery replacement*. https://www.ifixit.com/Guide/Microsoft+Zune+30+GB+Battery+Replacement/1230
INCOSE. (2015). *Systems engineering handbook: A guide for systems life cycle processes and activities* (4th ed., D. D. Walden, G. J. Roedler, K. J. Forsberg, R. D. Hamelin, & T. Shortell, Eds.). John Wiley & Sons, Inc.
iPodBatteryDepot. (n.d.). *Ease of installation for each iPod and iPhone*. https://www.ipodbatterydepot.com/easytoinstall.asp
Isaacson, W. (2011). *Steve Jobs* (1st ed.). Simon & Schuster.
ISO/IEC/IEEE. (2017). *ISO/IEC/IEEE 24765:2017(E): ISO/IEC/IEEE international standard - Systems and software engineering–Vocabulary*. IEEE.
Kim, J. (2006). *Inside details about Zune's battery life. Some inside details about Zune's battery life*. c|net. https://www.cnet.com/culture/inside-details-about-zunes-battery-life/
King, M. (n.d.). *How do I turn on my Zune?* CHRON. https://smallbusiness.chron.com/turn-zune-53456.html

Letzing, J. (2009). *What's to become of Microsoft's answer to the iPod?* MarketWatch. Available at: https://www.marketwatch.com/story/microsofts-zune-continues-to-struggle-2009-07-29
Lowkey Bre. (2021, October 11). *Zune unboxing in 2021| Microsoft Zune 30GB review | I bought a Zune in 2021 | Failed review in 2021?* [Video]. YouTube. https://www.youtube.com/watch?v=UO41UhPXmOA
Marsal, K. (2009). *Apple accused of stalling iPod battery fire investigation*. Apple Insider. https://appleinsider.com/articles/09/07/22/apple_accused_of_stalling_ipod_battery_fire_investigation
Microsoft Corporation. (2008). *Form 10-Q*. Securities and Exchange Commission. https://www.sec.gov/Archives/edgar/data/789019/000119312509009386/d10q.htm
Microsoft Corporation. (n.d.). *Zune player product manual*. https://www.microsoft.com/en-us/download/details.aspx?id=30468
Miller, P. (2008). *Zune breaks 2 million sold, stealing market from* Cr*eative not Apple*. engadget. https://www.engadget.com/2008-05-10-zune-breaks-2-million-sold-stealing-market-from-creative-not-ap.html
Monat, J. (2009). The benefits of global scaling in multi-criteria decision analysis. *Judgment and Decision Making*, *4*(6), 492.
Montalbano, E. (2006). *Microsoft's Zune to ship Nov. 14, cost $249*. Computerworld. https://www.computerworld.com/article/2547041/microsoft-s-zune-to-ship-nov--14--cost--249.html
orangey456. (2015, July 23). *iPod nano 5th generation retro review!* [Video]. YouTube. https://www.youtube.com/watch?v=jWgqIYfnLoA
Oiaga, M. (2006). *$750 orange Zune goes unsold first pink now orange*. Softpedia News. https://news.softpedia.com/news/750-Orange-Zune-Goes-Unsold-43174.shtml
Quilty-Harper, C. (2007). *Official pink Zune gets 100,000 unit production run*. engadget. https://www.engadget.com/2007-04-07-official-pink-zune-gets-100-000-unit-production-run.html
Radle, B., & Bradicich, T. (2019). *What is serviceability?* National Instruments. https://www.ni.com/en-us/innovations/white-papers/13/what-is-serviceability-.html
Stars and Décor Co. (n.d.). *Zune 30 GB digital media player (black)*. https://starsanddecor.com/products/zune-30-gb-digital-media-player-black?_pos=1&_psq=zune&_ss=e&_v=1.0 [Accessed: 19-February-2022]
Taylor, D., & Goss, C. (2022). *DoD's inflation challenge*. Federal Budget IQ. https://federalbudgetiq.com/insights/dods-inflation-challenge/
Wortham, J. (2008). The day the Microsoft Zunes stood still. *The New York Times*. https://web.archive.org/web/20130522085019/http://bits.blogs.nytimes.com/2008/12/31/the-day-microsoft-zunes-stood-still/?hp

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