IT Identity and Risk in Software Development

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Abstract

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Software project failure continues to be a concern and managing risk our best hope of project success. While IS literature has investigated the role of culture in projects, such cultural work is largely limited to the management of multinational project work and focused on ethnic or national identities and their impact on enterprise-level system development. Recently, information systems researchers have begun to focus on how a user's identities—their internalization of cultural meaning—can affect adoption and use of technology, but *identification with technology may also impact its development*. This study examines the ways in which worker identification with the technological outcome of a project affects team member attitudes and behaviors and, therefore, the project's risk profile. The results inform both theory and practice, contributing to IT identity research as well as best practices for project and risk management in software development.

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Chapter 1. OVERVIEW

The software development industry is experiencing slow improvement in the realm of project success, but professionals and academics still find concern with each year's rate of failed projects despite decades of research regarding project management. Recent responses to the annual Pulse of the Profession survey by the Project Management Institute (PMI)—the largest international organization of project managers both within and outside the software domain—show that participants classify 35% of organization projects as "failed project, budget lost" and an additional 12% of projects were "deemed failures" (PMI, 2021, p. 4). Project success and failure is usually based on adherence to three project parameters, often called the *triple constraint* or *iron triangle*: 1) the time estimated to complete the project (the schedule); 2) the funds and other expendable resources required to complete the project (the budget); 3) and the specified functionality of the project's deliverables (the scope) (Lee, 2010). Industry analysts provide snapshots of the cost of software failures to industry: "On average, large [information technology (IT)] projects run 45 percent over budget and 7 percent over time, while delivering 56 percent less value than predicted. Software projects run the highest risk of cost and schedule overruns" (Bloch, Blumberg, & Laartz, 2012). (Since the term "constraint" is used in other ways in the context of this work, references to this trio of evaluative criteria for projects will be called "iron triangle" in the remainder of this work.)

Defining risks as "factors that can, when present, adversely affect a project" (Wallace & Keil, 2004, p. 68), we understand why managing project risk is a fundamental aspect of the project management profession. In the project context, risk is often expressed as threats to the iron triangle. Continued research into software project risk promises improvements to project success rates by helping software professionals identify, understand, and address these potential problems within their projects.

A great deal of research has gone into identifying risk factors in the context of IT development projects. While there is no single accepted list of software project risk factors, multiple researchers have developed their own classification systems, largely based on studies of practitioners (e.g. Schmidt, Lyytinen, Keil, & Cule, 2001; Taylor, 2006; Wallace & Keil, 2004). Among the common sources of risk identified by these studies are risk factors associated with uncertain or changing project scope (a concept often expressed colloquially as *scope creep* or

feature creep), as well as many factors associated with staffing, technology, and organizational culture. Staffing and technology factors often seem to overlap, as they tend to be framed in terms of staff skill, experience, or familiarity with technology.

While project literature has further investigated the role of culture as an aspect of project risk, work is largely focused on the effects of organizational culture on the development process (e.g. Leidner & Kayworth, 2006) or on gender, ethnic, or national identities, and often focus on their impact on multinational system development efforts (e.g. Rai, Maruping, & Venkatesh, 2009). However, worker identities (their internalization of cultural meaning) extend far beyond their affiliation with work units or their country of origin.

In this body of literature, the focus is often on organization managers who have traditionally been responsible for project- and risk-based decision-making (e.g. Khan & Kumar, 2009; Taylor, 2007). In recent years, the growth in popularity of agile development methods has changed the nature of decision-making on project teams. In agile work, it is much more likely that innumerable decisions are being made by project team members working in concert with clients. "This creates a pluralist decision-making environment due to the diverse backgrounds, attitudes, goals, and cognitive dispositions of the team members" (Nerur, Mahapatra, & Mangalaraj, 2005, p. 76). For project managers, this distribution of decision-making can add complexity to project tracking and change management.

According to the PMI (2018), 87 percent of organizations reported "using agile approaches for their projects sometimes, often, or always" (p. 4). With contemporary IT development continuing to become more agile, and with agile development distributing decision-making through product teams rather than concentrating it on management, it becomes important to understand the decision-making behavior of project team members.

Recently, information systems (IS) researchers have begun to examine how individuals self-identify with technology (Carter & Grover, 2015) and how this self-identification affects adoption and use of IT. We have not yet begun to explore how self-identification with technology impacts its development. By self-identifying with the IT under development, project workers' behavior—including risk behaviors—may be affected in significant ways and therefore impact the course of the project and its final product.

1.1 OBJECTIVES

This research is intended to inform IT identity, project management, and project risk management practices. It examines the manner in which individual IT project team members self-identify with the products they are developing and explores the relationship between self-identification with the IT under development and risk-related project behavior for the purpose of informing IT identity research and improving project and risk management practices. It seeks empirical evidence that such self-identification takes place on project teams and the conditions in which it may occur. While there are multiple ways that personal decisions may affect projects, this work focuses on critical decisions that involve choices which would accept or prevent feature creep.

1.2 RESEARCH QUESTION

Stated formally this research addresses the following question:

- In what ways, if any, does self-identification with an IT under development affect project team members' personal risk-related decision-making behavior on IT projects?

"Risk-related" indicates that the investigation will involve critical incidents that may have resulted in substantial changes to the product evaluative criteria. "Decision-making behavior" does not involve objective evaluation of decisions on the outcomes of the project, only on personal behavior that constitutes input or opinion.

1.3 THEORETICAL PERSPECTIVES

This work will be conducted within a framework of structural symbolic interactionist theories regarding identity (*identity theories*) including Carter & Grover's (2015) application of these theories in the IS domain through their theorization of IT identity. This framework also includes elements from British cultural studies—whose researchers often work from a symbolic interactionist perspective (Becker & McCall, 1990)—to explain the cultural source of our identities.

British cultural studies (or simply *cultural studies*) is an approach "dedicated to the notion that the study of cultural processes, and especially of popular culture, is important, complex and both theoretically and politically rewarding" (Grossberg, Nelson, & Treichler, 1992, p. iv). It

attempts to explain how social meaning is created, and is partially based on the works of Saussure and Foucault in linguistics, semiotics, and discourse (Turner, 2003; Weedon, 1994). It contends that “culture is a terrain on which there takes place a continual struggle over meaning” (Storey, 1994, p. ix), and that "when we are at our most natural, our most everyday, we are also at our most cultural.... when we are in roles that look the most obvious and given, we are actually in roles that are constructed, learned and far from inevitable" (Willis, 1979, p. 185).

Cultural studies views economic systems in a cyclical relationship with culture. All industry comes into existence within a cultural context, but then products from those industries can influence culture (Hesmondhalgh, 2012; Willis, 1994). This is especially true of products from the *cultural industries*. Organizations are categorized as part of the cultural industries “because **they deal primarily with the industrial production and circulation of texts**” (Hesmondhalgh, 2012, p. 6) and “are most directly involved in the **production of social meaning**” (Hesmondhalgh, 2012, p. 16) [emphasis in original]. Along with digital games (which are a segment of IT as well as part of the cultural industries), the list of cultural industries includes journalism, film, television, radio, and marketing. Their basic products (e.g. games, articles, movies, programs, and advertisements) are in a class that cultural studies scholars refer to as *cultural texts*. For these, the intent of production is less about utility than conveying a message of social significance (Hesmondhalgh, 2012). By contrast, television manufacture is not part of the cultural industries: While all objects have some social meaning by simply existing within society, a television is primarily an electronic good that affords consumers a utilitarian function (interpreting audio and visual signals) rather than a cultural text. This is true even though a television is used to consume cultural texts.

Identity theories share many structuralist and post-structuralist concepts with cultural studies. They contend that one’s sense of self is comprised of many identities, each of which is the personal internalization of the meaning one finds in society. The set of meanings attached to each identity is its *standard*. While an identity may be shared among many, each individual’s standard for an identity is unique: Many see themselves as scholars, but no two scholars have the exact same standard (Burke & Stets, 2009).

Identities tend to be classified into one of four types. Most heavily analyzed in identity literature are *role* identities, which internalize society’s expectations for individuals acting in a given societal role (Burke & Stets, 2009). “Educator,” “worker,” and “parent” are all examples of

role identities and may even all be part of a single individual's self-concept. *Group* identities serve a similar function for members of groups (Burke & Stets, 2009), including religious, ethnic, and cultural groups. *Person* identities are those that attempt to distinguish one as a unique individual (Burke & Stets, 2009). "Trustworthy," "frugal," and "artistic" are all examples of person identities. More recently, researchers have explored *material* identities, tied to possessions or places (Clayton & Opotow, 2003; Tian & Belk, 2005), which are constructed and function like role, group, and person identities. These can be with most any physical or conceptual thing or class of things: A theoretical framework, a make of car, or a software package. IT identity is theorized as a new form of material identity.

While Carter and Grover (2015) originally conceived of IT identity as a positive self-identification with an IT, exploration has also shown that some negatively self-identify with an IT (Carter, Compeau, & Schmalz, 2018). IT identities are independent of expertise with an IT: A person can be an expert with a given technology and still feel it has little to do with who they are (dis-identification) or even antithetical to who they are (anti-identification). For example, a competent MacOS user may feel that OS is antithetical to who they are, perhaps having a positive IT identity involving Windows or a flavor of Linux.

These identities are the source of our behavior. As different social situations arise, some of one's identities become more salient, and one acts in accordance with the standards of those identities, confirming them as part of one's self. The salience hierarchy of one's identities is determined by a number of factors, including one's default sense of self (their *prominence* hierarchy of identities), one's perceptions of the ways in which identities have been *supported* and *rewarded* in the past, and the perceived *opportunities* for reward and support involved in the current situation. Supporting behavior associated with an identity also reinforces that identity, making it more prominent in one's self and more likely to become salient again in the future (Burke & Stets, 2009).

IT project team members presumably have a number of identities that may become salient during the course of a project and govern behavior on project teams. While project and risk management researchers have studied the impact of culture on development, these efforts usually focus on the interactions of national cultures in multinational development efforts (e.g. Rai et al., 2009) or the effects of organizational culture on the development process (e.g. Leidner & Kayworth, 2006). Intentionally or otherwise, these studies have focused on group identities and

may be overlooking other identities affecting project behavior. By utilizing IT identity's conceptualization as a form of material identity, this research adds material identities to the scope of project-culture or project-identity studies, examining the manner in which self-identification with the IT under development affects specific risk-related project behaviors involving changes to project scope. We expect these identities to appear more frequently and to be relatively stronger when developing IT that has a larger cultural presence, with digital games on one end of the spectrum and infrastructure or management information systems representing the other end as highly utilitarian IT.

1.4 CONTRIBUTIONS

This study has implications for both theory and practice. The work has the potential to extend IT identity theories by specifically investigating the effects of IT identity on IT project behavior and the development of IT. Even if the study finds no evidence that project worker self-identification with the IT under development affects project behavior, this would be an important finding for IT identity research. If such self-identification is discovered to be part of team member decisions, the results will also offer insights into the content of IT identity standards and the behavioral effects of self-identification with IT, which will further inform future IT identity research. The work proposes and analyzes a new set of indicators for IT identity which are applicable to both the development of IT as well as its use, comparing them to current IT identity indicators, which will either validate the current set of indicators or introduce an improved set.

Practically, the work also has the potential to inform human resource decisions and risk management techniques in digital game, consumer IT, and other forms of technology development. If the study shows a correlation between identification with technology and risk behavior on technology projects, the nature of the relationship will be able to inform an organization's human resources, training, and technology decisions. It may become possible to identify better hires for project work not only by their skill sets, but also by the manner in which they self-identify with the technologies involved.

1.5 ORGANIZATION

The remaining text proceeds as follows: Chapter 2 contains a detailed literature review of concepts within project management literature as they pertain to this research; Chapter 3 contains information regarding the theoretical framework; Chapter 4 covers the methods survey instrument creation, recruitment, data gathering, and analysis, and introduces a new theoretical model; Chapter 5 reviews findings; and Chapter 6 concludes with a discussion of the contributions of the work.

Chapter 2. PROBLEM DOMAIN LITERATURE REVIEW

This research project concerns worker identities and their effects on software project risk behavior. It is inspired by the emergence of IT identity work within the IS domain and reflects an understanding that identity frameworks have not been applied to software project risk. A literature review of this problem domain is required to create a more complete understanding of software project risk and its intersections with concepts from IT identity scholarship. (IT identity scholarship is explored in depth in Chapter 3 of this work.)

2.1 LITERATURE SEARCH

This review was completed in the context of a broader literature review on the subject of IS conceptualization of software project risk. For the broader review, the Association for Information Systems' electronic library (AISeL) was used to conduct a search on May 21, 2019, using the search phrase '"risk management" AND "project management"'. The search was constrained to peer-reviewed articles. This produced a list of 345 articles. The results were imported into a spreadsheet for tracking, and the articles were reviewed in chronological order by year of publication. Those articles which could not be reliably excluded based on their titles and abstracts were opened and the body searched using "risk" or "risk management" to determine how risk was represented. Articles which included analysis or classification of risk factors as they pertain to IT development were retained, including those defining and exploring a single category of risk. Examples of rejected article types include those where risk management was presented as a job skill, a teachable specialization within project management, or as specializations within information security, operational, or financial risk management. Promising references were also followed to uncover additional related material outside of the AISeL, resulting in 83 additional sources which were reviewed. This set was supplemented by an additional AISeL search in June, 2022 which produced 25 matches for the terms above for the period of 2019-2022, which were also reviewed.

Below, we start with a general description of the major concepts of the broader domain of project management, and focus on the concepts of risk management, identify several established works dealing with the conceptualization of risk in the domain, and analyze those sources to uncover the way in which they explore risk using the areas of focus mentioned above.

2.2 Project and Risk Management

The PMI defines a project as a "temporary endeavor undertaken to create a unique product, service or result" (PMI, n.d., para. 1). Unlike many other business functions, project work has a defined start and endpoint. Projects also serve to create something new and unique: The design of a new smartphone would be a project, but each smartphone produced is part of an ongoing process and not a project itself.

While the modern concept of a project manager arose in the late 1950s, project managers have practiced for millennia. For example, the Great Pyramid of Giza, built over two to three decades and finished circa 2560 BCE, was not created by a single individual or through random chance. Rather, people conceived of the structure, planned its construction, and executed the plan while monitoring progress until completion.

In the modern project context, as well as most research studying technology development projects, risk is often expressed as threats to the iron triangle of time, cost, and scope of a project (Lee, 2010). Some espouse more performative criteria for project success (Cecez-Kecmanovic, Kautz, & Abrahall, 2014). Performative evaluations necessarily include evaluation of portfolio management (practices for identifying, evaluating, comparing, and selecting projects that match an organization's capabilities and objectives (Ross & Shaltry, 2006)) and benefits realization management (practices intended to specify and document the intended benefits of projects and then evaluate those benefits after project completion (PMI 2016)). This work considers risk during the project lifecycle from the point a project is chartered through the point where it is closed, as project staff are focused on creation of a set of chartered deliverables.

Commonly, one might define risk as *exposure to danger, harm, or loss* (Oxford University Press, 2019). Many disciplines—among the most prominent are finance, organizational operations, and IT security—include a specialized concept of risk, how it affects practice, and how it can be understood and controlled to minimize danger, harm, and loss. This work focuses on risk as addressed in the domain of IT development projects.

Defining IT *project risks* as "factors that can, when present, adversely affect a project" (Wallace & Keil, 2004, p. 68), we understand why managing project risk is a fundamental goal of project management. For this work, we will define *risk factors* as categories of possible risk for a project (e.g., "Loss of critical staff"), risks as specific instances of a risk factor (e.g., "Our lead

developer may retire during the project"), and problems as events that are present and adversely affecting the project (e.g. , "Our lead developer has announced their retirement").

Since contemporary project managers have most often expressed success as meeting a project's planned schedule, budget, and specification, risk has been primarily analyzed as the potential for events that negatively impact those criteria. If one considers more performative criteria for project success, factors that might adversely affect those criteria are still risks by this definition.

The PMI considers risk management to be one of the required skills for a competent project manager (PMI, 2009): "Project Risk Management includes the processes concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project" (p. 4). The PMI concept of risk also includes the possibility of positive risk (the potential for an unexpected positive event that a project team would want to exploit to their advantage), which is out of scope for this research project. Risk management practices are intended to minimize the probability of risks from becoming actual problems, and to minimize the impact of these problems if they do occur; the benefit or reward for accepting project risk is being able to follow a project plan with more efficient schedules, less costly budgets, and an effective feature set than if every risk was fully addressed before starting.

In one fashion, all of project management is a form of risk management. There would be no need to follow any project management processes if there was no risk involved in execution. For example, the choice of project management frameworks (waterfall vs. agile, for example) implicitly includes a decision regarding which methodology will likely produce the best results, adopting the inherent risks of one framework over those of another because one is considered less risky, overall. An organization's decision to use project management practices is *organizational* risk management: deciding to invest in project management staff, overhead, and practices in order to reduce the chance of failure in important activities, and that decision takes place before a project begins. This research focuses on *project* risk management which occurs during the project lifecycle. As with other domains where risk is studied to stop or decrease the impact of dangers, losses, and harm, continued research into software project risk provides increased understanding of why projects underperform or fail and promises improvements to project success rates by helping software professionals better identify, understand, and address potential problems within their projects.

The PMI suggests consulting lists of known risk factors as one possible way to identify specific risks on a given project (PMI, 2009). In using such a list, each risk factor is treated as a prompt for consideration of the ways in which a project may be impacted by specific risks related to that risk factor. This process sometimes includes developing proactive steps for preventing the risk from becoming a problem, measures for determining whether or not the risk has become a problem, and contingencies for action when the risk becomes a problem (Larson & Gray, 2018). For example, if one is prompted by a risk factor called "Upper Management Support," one may identify a specific project risk regarding the need for continued support from a particular key executive at the company where the project takes place, make plans for regular communication with that executive to maintain their support, develop a means of measuring the executive's current disposition, and define a set of actions to take if the executive pulls support for the project. While these lists can be very helpful in analyzing risks associated with a project, the PMI does not offer its own list of risk factors for software development projects.

In academia, several research efforts have attempted to identify risk factors in the context of IT development projects. While the literature provides no single accepted list of software project risk factors, multiple researchers have developed their own lists and classification systems, largely based on studies of project or risk management practitioners (e.g. Barki, Rivard, & Talbot, 1993; Jones, 1994; Schmidt et al., 2001; Taylor, 2006; Wallace & Keil, 2004). As with any classification system, these risk classification efforts also illustrate the ways in which IS scholarship conceptualizes the domain, guiding both research and practice.

2.3 Culture and Identity in Risk Literature

Our sense of self is comprised of many identities that are formed by processing *cultural meaning* found in society. These identities can involve one's roles in society (*role identities*), one's membership in groups (*group identities*), the qualities one believes distinguishes them as an individual person (*person identities*) (Burke & Stets, 2009), and things with which one self-identifies. While this last class of identities can be with physical or conceptual things, the class is commonly referred to as *material identities* (Clayton & Opotow, 2003). Our perceptions of our environment cause identities to become situationally salient, and our behavior the way we self-confirm the *standards* (values and meanings) of those salient identities (Burke & Stets, 2009).

Without directly utilizing identity theories, researchers have coincidentally explored ways in which projects are impacted by workers' role, group, and person identities. Project management literature has investigated the role of culture as an aspect of project risk, largely focused on the effects of organizational culture on the development process (e.g. Leidner & Kayworth, 2006) or on gender, ethnic, or national identities, and often focus on their impact on multinational system development efforts (e.g. Rai et al., 2009). With identity theories, these constitute studies of group identities ("I am a [nationality]"; "I am a [company] employee") or role identities ("I am a [job role]"). Job descriptions often frame person identities as job requirements ("I am dedicated"; "I am organized"; "I am a multitasker"). Little, however, has been done concerning material identities in the workplace (cf. Tian & Belk, 2005) and less (perhaps none) regarding the impact of those on performance. The recent work regarding IT identity—conceptually defined as a material identity—is a catalyst for researchers to investigate the impact of worker identification with their (material) project outcomes.

Our identities are important, in part, because they explain our behavior. For any given situation, a person's identities can change in salience. That person then acts in accordance with the standards of their most salient identities, confirming them as part of their self. In the context of identity theories, project and risk management research has done incomplete work to tell us *who developers are* while at work and when making decisions affecting their projects. Project workers, confronted with daily decisions regarding their projects, certainly verify those identities by making choices that confirm the content of their identities. However, our existing risk frameworks tend to consider workers as collections of skills rather than individuals with identities. While skills affect a worker's ability to perform tasks, their identities drive their actual behavior.

IT identity has built upon identity theories to explain why understanding an individual's material self-identification with technology is vital to understanding technology adoption and use behavior. This could affect IT project worker use and adoption of tools, including integrated development environments, version control systems, company-provided computers, and office productivity packages. Outside of adoption and use, IT identity research also promises that understanding a technology worker's self-identification with the technology they are producing is vital to understanding project team behavior. It is possible that identification with a project's technology, including the intended final product, affects many of the risk factors identified in risk management literature. Whether or not IT identities are found to be particularly important, there

remains the issue of understanding which other identities are salient during project work, and how self-confirming behaviors from different identities affect project behavior. The salient identities and their self-confirmatory behaviors will affect project member interactions with their co-workers and their performance of their work duties.

2.3.1 *Digital Games as a Highly Salient Context*

Within the digital games industry, academic and popular coverage shows that the industry tends to hire game enthusiasts as gameworkers (Dovey & Kennedy, 2006; Kerr, 2006). All IT segments undoubtedly hire experts in specific technologies, but hiring practices in digital games may lead to environments in which more of the tech workers have strong IT identities regarding their intended product. These practices may cause non-game developers to behave in accordance with more role, group, and person identities than with their material self-identification with their product. For example, a worker who identifies as a player of driving games who participates on a project team developing a driving game may exhibit self-confirmatory behaviors that impact project performance and outcomes: "We need to adjust the schedule so we can add a feature to make our game more appealing to players like me." By taking actions to make a game this individual would personally like to play, they are confirming their own identity and subjecting the project to additional risk to do so. This effect may appear less often in the development of asset management packages, where the products are not cultural texts. For these reasons, this investigation of material self-identification on project teams will draw from multiple sectors of IT development, including digital games.

2.3.2 *Project Management and Theory*

Overall, project management is largely lacking a strong, central theoretical base. For example, Wallace, Keil, & Rai (2004) note a "lack of theory to explain the linkages between various dimensions of software project risk and project performance" (p. 289). Approaches have been largely practical in nature while touching on a wide variety of theoretical frameworks. For example, Bérubé and Gauthier (2017) use a framework of justification to explore project management, which has its roots in political economy scholarship; Barki et al. (2001) rely on organization theory; and Shmueli et al. (2015) study three very specific sociological "behavioral effects" in order to examine personal behavior in software development projects. Identity theories

and IT identity offer a new context in which an established theoretical framework may be used by researchers to approach project and risk management in a new and meaningful manner.

2.4 Agile Methodologies and Open-Source Software

Changes to development practices also bring a need for new investigations of project risk. Prior research tends to focus on organization managers who have traditionally been responsible for project- and risk-based decision-making (e.g. Khan & Kumar, 2009; Taylor, 2007). In recent years, the growth in popularity of agile development methods and open-source software have changed the nature of decision-making on project teams.

In a 2017 report, "71 percent of organizations [reported] using agile approaches for their projects sometimes, often, or always" (Project Management Institute, 2017, p. 4). In agile work, it is much more likely that innumerable decisions are being made by project team members working in concert with users. This distribution of decision-making complicates project management and has increased chances of introducing competing agendas to the process, introducing additional risks to the project when compared to environments where important decisions are made by project management staff (Nerur et al., 2005).

With cultural products, we also expect a higher tendency for workers to consider themselves part of the target audience than in utilitarian, internal projects such as inventory management systems. This self-identification of the tech worker as the end user may indicate self-identification with the product, may cause differences in identity salience when compared to other sorts of development, and therefore increase the impact of individual decisions on IT projects.

In a similar manner, Howison & Crowston (2014) found that most of the work tasks in Free/Libre/Open-Source Software (FLOSS) projects are completed by individuals and tasks too large for an individual are deferred. FLOSS developers often self-select for projects, so motivations can vary from those of developers paid by an organization who determines what work is done. FLOSS motivations include "[improving] open-source products of other developers [...and solving] a problem that could not be solved by proprietary software" (Krishnamurthy, 2006, p. 24). While other motivations exist, these two may indicate that the FLOSS developer is also a user of the product under development and may self-identify with the product.

With contemporary IT development continuing to become more agile, the continued popularity of the open-source model, and decision-making is becoming more distributed through

product teams rather than concentrated on management. It is important to understand the decision-making behavior of individual project team members.

2.5 Culture, Identity, and Decision-Making in Software Development Literature

Software development researchers have indirectly dealt with issues of culture and identity in much the same way project management researchers have.

A search of Google Scholar shows 87 articles that match the search term "software development projects" and cite Ilgen, Major, Hollenbeck, & Sego (1995), who examine decision-making in teams at both the individual and group level. Group decision making usually involves the weighing of individual opinions by an individual who bears ultimate responsibility for the choice, as a multitude of perspectives resolve into a single direction for the whole group. The theoretical framework for this research project applies to individuals, not groups. While the mechanics and effects of group decisions are certainly of interest to industry, this work focuses on individual behavior and explores how individual identities drive individual opinions about those decisions, not the actual choices made nor the effects or outcomes of those choices. Group decision-making models are out of scope for this research project.

Regarding individual decision-making, Ilgen et al. (1995) state:

> "Each team member may reach a decision on the basis of some consideration of a set of cues and their weights. Within the team, however, individual members may have information about different cues. Individuals within the team may also have different weights for the same cues. The nature of the distribution of knowledge about cues and their weights, as well as the nature of the interaction among the team members in the decision process, is in part a function of previously established roles and individual differences" (p. 116-117).

When viewed through an identity theory lens, cues are symbols found in the work setting that affect the salience of identities in an individual worker, and salient identity standards are enacted through worker behavior. Each individual's unique weights for given cues is a function of variation in a common identity, the presence of different identities, or differences in the prominence (default) hierarchy of each individual's identities.

Like project management literature, software literature tends to represent tech workers as collections of skills. For example, Kapur et al., (2008) devise a system for optimizing project labor by comparing required tasks and skills. However, each worker also has their own individual set of identities comprising their sense of self. While some behaviors are not possible without enabling knowledge or skills, behaviors are individuals enacting salient identities.

There are two forms of individual decision-making behavior studied in the software development context: *prescriptive* (or *rational*) decision-making which attempts to determine the optimal solution from a set of options and *descriptive* (or *naturalistic*) decision-making which involves less rigorous serial evaluation of options as the individual attempts to quickly reach a course of action which satisfices for the given situation (Drury et al., 2012; Zannier et al., 2007). Eseryel et al. (2019) includes individual decision making as one of six areas of FLOSS development. While many sources focus on a developer's decisions to adopt and continue to work with a FLOSS project, others have investigated task selection and design concerns, such as when to re-use code.

Regarding the behavior of software team members, Sawyer & Annabi (2006) claim: "Software development methods are explicit representations of:

1. how people should behave,
2. how groups of people should interact,
3. the tasks that people should do,
4. the order of these tasks,
5. the tools needed to achieve these tasks,
6. the proper outcomes of these tasks (including means and ways to evaluate these outcomes) and
7. the means to make this all happen.

The relations among these concepts are further set in (8) specific contexts, implying that the exact nature of such relations are contingent to some degree on the larger social milieu" (p. 400).

Using identity theories, we understand that the behavior of individuals on software development teams is the enactment of their identities' standards. For most, this would presumably include an identity associated with their "software developer" role. While some frameworks attempt to examine group behavior, identity theories instead focus on the individual's identity as

a member of the group and their internalization of the social meaning they assign to that group (an individual's group identities). These observations encompass items 1, 2, 3, and 4 in the list above.

Item 5 implies a relationship between the standard of the software developer identity and the tools of the trade. Through the identity theory lens, it is possible to see tool selection and use as a function of the software developer role identity or to see it as self-identification with the tool (another form of material identity). Item 6 involves evaluation of outcomes, which is a behavior that would be associated with one or more of the individual judge's identities. Item 7 is about incentives: "The structures put in place to encourage positive, and discourage negative, behaviors and interactions" (p. 400). Incentives can activate identities and change their salience, producing changes in individual behavior.

Item 8 makes plain that the specific standard of each of these identities is formed within a social context, and that identity standards should be expected to differ at least slightly from individual to individual, as expected. It also means that different identities may become salient in these different contexts. We cannot expect that a software developer identity is always the salient identity, even in the workplace.

In this short excerpt, we have software development methods expressed indirectly in terms that imply their sources are role identities, group identities, and even material identities. Software methods are a reflection of the societal meaning that each individual project team member internalizes to create their own identities and expose common elements of identity standards.
While material identities are implied related to work tools, what is apparently missing is the concept of self-identification with the IT under development (though perhaps that is considered part of the context of the development and part of item 8). Software development methods may also be a representation of the material identities that team members have regarding the product under development. Software development behavior may change based on what is being produced, and the self-identification that each member of the team has with the product under development.

2.6 SUMMARY

Software project failure continues to be a concern and managing risk our best hope of project success. Risks related to staff are often implicitly or explicitly based on skills, and while skills may affect a worker's ability to perform tasks, their actual behavior is the enactment of their identities. Identities are internalized cultural meaning, and while IS literature has investigated the role of

culture in projects, such cultural work is largely limited to the management of multinational project work and focused on ethnic or national identities and their impact on enterprise-level system development. Studies regarding worker identification with the product of their work were not found in an extensive review of IS or software literature, though analysis shows that identity theories can be used as a lens to explain findings in existing literature. As such, identity theories are a promising, novel framework with which to examine individual project worker risk behavior to increase IS project performance by improving our understanding of IT project and risk management.

In the following chapter, we will more thoroughly explore the framework of identity theories that will be used to explore this problem domain.

Chapter 3. THEORY AND HYPOTHESES

This chapter is intended to summarize research regarding culture, identity, and risk management that helps address the research project research question: “In what ways, if any, does self-identification with an IT under development affect project team members’ personal risk-related decision-making behavior on IT projects?” This theoretical framework is then used to suggest a theoretical model for IT identity in the IT development context.

This research project is conducted within a framework of structural symbolic interactionist theories regarding identity (*identity theories*) including Carter & Grover’s (2015) application of these theories in the IS domain through their theorization of IT identity. This framework also includes elements from British cultural studies (or simply *cultural studies* outside of the US (Turner, 2003)) to explain the cultural source of our identities. Cultural studies researchers often work from a symbolic interactionist perspective (Becker & McCall, 1990), making them an excellent fit with identity theories. After a review of cultural studies and identity theories literature, this chapter proceeds with a review project and risk management literature, including a discussion of the applicability of identity theories within project and risk management research. Finally, the new model is described.

3.1 THEORETICAL BACKGROUND

Cultural studies is a common term for an approach for research into culture that had an early home at the Birmingham Centre for Contemporary Cultural Studies (CCCS) in the 1960s. It is an approach to the study of culture that is “dedicated to the notion that the study of cultural processes, and especially of popular culture, is important, complex and both theoretically and politically rewarding” (Grossberg et al., 1992, p. iv). It attempts to explain how social meaning is created, and is partially based on the works of Saussure and Foucault in linguistics, semiotics, and discourse (Turner, 2003; Weedon, 1994). It contends that “culture is a terrain on which there takes place a continual struggle over meaning” (Storey, 1994, p. ix), and that "when we are at our most natural, our most everyday, we are also at our most cultural.... when we are in roles that look the most obvious and given, we are actually in roles that are constructed, learned and far from inevitable" (Willis, 1979, p. 185).

Linguistically, there is no inherent link between a word and what it represents. The word "dog" only has meaning because English speakers agree by convention that it does. Other languages have other words to represent the same concept. Further, any distinction between "dog" and "mutt", "dog" and "wolf", or "dog" and "cat", are also cultural. It is convention and not universal natural law that gives these words meaning. Beyond linguistics, these principles also apply to other forms of communication, including "non-linguistic systems such as those governing images, gestures or the conventions of 'good manners'... seeing them all as 'signifying systems'" (Turner, 2003, p. 13) that allow humans to construct shared meaning.

While some disciplines study culture as a society's ideals, and others define culture as the major artistic works of a society, cultural studies sees culture as the *daily lived experience* of members of a society or group. While this definition includes the material found in those narrower concepts of culture, cultural studies research includes "analysis of elements in the way of life that to followers of the other definitions are not 'culture' at all: the organization of production, the structure of the family, the structure of institutions which express or govern social relationships, the characteristic forms through which members of the society communicate" (Williams, 1998, p. 48).

Bourdieu (2010) explains this tenet by stating that "one cannot fully understand cultural practices unless 'culture', in the restricted, normative sense of ordinary usage, is brought back into 'culture' in the anthropological sense, and the elaborated taste for the most refined objects is reconnected with the elementary taste for the flavours of food" (p. xxiv). This concept of culture motivates cultural studies scholars to analyze the symbols and meanings within popular culture, which other disciplines tend to reject.

These meanings of the symbols we find within society are never fully settled. Cultural studies "assumes that capitalist industrial societies are societies divided unequally along ethnic, gender and class lines [and that] culture is one of the principal sites where this division is established and contested" (Storey, 1994, p. viii).

> "Because different meanings can be ascribed to the same cultural text or practice, meaning is always the site and the result of struggle. A key question for cultural studies is: Why do particular meanings get regularly constructed around particular cultural texts and practices and achieve the status of 'common sense', acquire a certain taken-for-granted quality? However, although the cultural industries are a

> major site of ideological production, constructing powerful images, descriptions, definitions, frames of reference for understanding the world, cultural studies reject the view that ordinary people who consume these productions are 'cultural dopes', victims of 'an up-dated [sic] form of the opium of the people'" (Storey, 1994, p. ix).

Given inequalities in society, "culture is a terrain on which there takes place a continual struggle over meaning, in which subordinate groups attempt to resist the imposition of meanings which bear the interest of dominant groups" (Storey, 1994, p. ix). These often-invisible power struggles over meaning are not a consequence of societal structure and history, but are its core. Cultural studies "argues that culture's importance derives from the fact that it helps to constitute the [social] structure and shape the history" (Storey, 1994, p. viii) rather than merely reflecting them.

Some of these struggles for meaning include forces from industry. Cultural studies views economic systems in a cyclical relationship with culture. All industry comes into existence within a cultural context, but then products from those industries can influence culture (Hesmondhalgh, 2012; Willis, 1994). This is especially true of products from the cultural industries. Organizations are categorized as part of the cultural industries "because **they deal primarily with the industrial production and circulation of texts**" (Hesmondhalgh, 2012, p. 6) and "are most directly involved in the **production of social meaning**" (Hesmondhalgh, 2012, p. 16) [emphasis in original]. Along with digital games (which are a segment of IT as well as part of the cultural industries), the list of cultural industries includes journalism, film, television, radio, and marketing. Their basic products (e.g. games, articles, movies, programs, and advertisements) are in a class that cultural studies scholars refer to as cultural texts. For all of these, the intent of production is less about utility than on conveying a message of social significance (Hesmondhalgh, 2012). By contrast, television and monitor manufacture is not part of the cultural industries: While all objects have at least some social meaning by simply existing within society, the primary goal of creating a television or monitor is the production of an electronic good that affords consumers a utilitarian function (interpreting audio and visual signals) and not the production of social meaning. This is true even though these products are used to consume cultural texts.

3.1.1 *Structural Symbolic Interactionist Identity Theories*

Identity theories share many structuralist and post-structuralist concepts with cultural studies. These theories seek to understand an individual's sense of self, examining "what it means to be who you are" (Burke & Stets, 2009, p. 3). Their application to IS research is exemplified by Carter & Grover (2015).

An individual's sense of self is "that which characterizes an individual's consciousness of his or her own being or identity. The self has the ability to take itself as an object, to regard and evaluate itself, to take account of itself and plan accordingly, it to manipulate itself as an object in order to bring about future states" (Burke & Stets, 2009, p. 32).

A person's sense of self is comprised of many identities, each of which is the personal internalization of the meaning that person finds in society. When we are born, we have no sense of self, but we are born into society. We create our selves from the meaning that we find in society—largely through the teachings of others in society, intentional or otherwise—and then we influence society by sharing those interpretations of society with others. In this way, individuals and society affect each other, but society always comes first since it existed prior to any person's birth (Burke & Stets, 2009). In the terms of cultural studies, we construct our sense of self through lived experience of the culture into which we are born and in which we live.

Each identity within a person's sense of self is an interpretation of concepts we encounter in society. We absorb information from our social environment about that environment and internalize the meaning we find there into our concepts of our self and of others. The set of meanings a person attaches to an identity is its standard. While an identity may be shared among many, each person's standard for that identity is unique: Many see themselves as scholars, but no two individuals have the exact same standard for their scholar identity (Burke & Stets, 2009). Despite these variations, scholars of identity theories assert that societal meaning changes slowly enough that generalizations can be made about individuals who share an identity in a given cultural context. This slow-changing societal structure gives structural symbolic interactionists their differentiation from symbolic interactionists (Burke & Stets, 2009).

Identity theories provide a set of motivations for an individual's identity formation and maintenance, including

> "to see themselves in a positive light (the self-esteem motive) [...], to believe that their identities are continuous over time despite significant life changes (the continuity motive), that they are distinguished from other people (the distinctiveness motive), that their lives are meaningful (the meaning motive), that they are competent and capable of influencing their environments (the efficacy motive), and that they are included and accepted within their social contexts (the belonging motive). Each of these motives has a theoretical basis for universality, but different cultures may develop different ways of satisfying them, so that the same underlying motives may have very different consequences in different cultural contexts" (Vignoles, 2011, p. 403).

These identities are not all of equal importance to an individual. The position of an identity within the default hierarchy of all one's identities is its *prominence*, while *salience* is situational. "The prominence hierarchy is more enduring and stable" while "the salience hierarchy is rather fluid as role identities become temporarily activated in different situations" (Burke & Stets, 2009, p. 41). This does not mean the standards of these identities change easily, just their position in one's salience hierarchy, as the situation dictates.

These identities are the source of our behavior. As different social situations arise, some of one's identities become more salient, and one acts in accordance with the standards of those identities, confirming them as part of one's self. According to a model specifically regarding role identities, the salience hierarchy of one's identities is determined by a number of factors, including one's ideal sense of self (their prominence hierarchy of identities), one's perceptions of the ways in which identities have been supported and rewarded in the past, and the perceived opportunities for reward and support involved in the current situation (Becker & McCall, 1990; Burke & Stets, 2009). Supporting behavior associated with an identity also reinforces that identity, making it more prominent in one's self and more likely to become salient again in the future (Burke & Stets, 2009).

While identities do change, they more commonly serve as stabilizers. When an identity becomes salient, a person tends to act in ways that maintains that identity, confirming or verifying it rather than changing it. Our reactions are based on perception, a function that is often compared to a thermostat, which will react to cool a room even if it only feels too hot because someone is holding a heat source to its sensors (Burke & Stets, 2009). When a person's perceptions tell them that they are not maintaining an identity standard, their behaviors will rectify that perceived error

until the standard is achieved (Figure 3.1). In this way, an individual's behavior is the enactment of their salient identity standards.

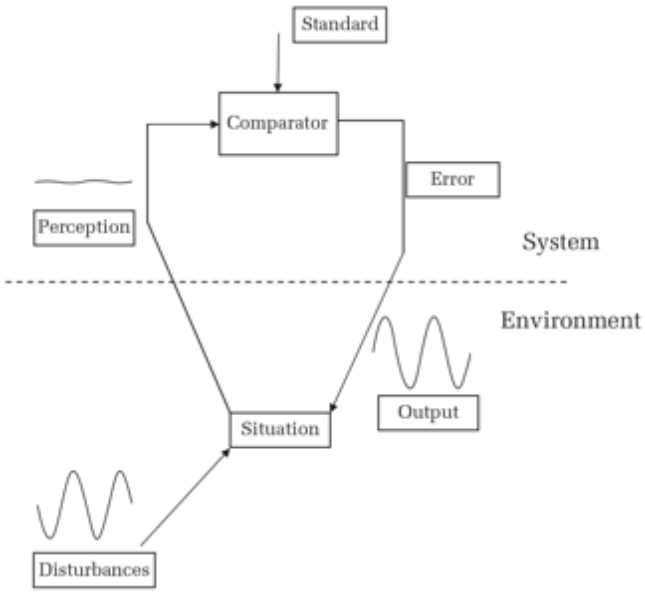

Figure 3.1. Perceptual Control Model (Burke & Stets, 2009, p 30)

Figure 3.2 illustrates ways in which behavior can be used to self-verify when a person's self-concept does not match one's perceptions. For example, a bad review might challenge a person's "teacher" identity. This incongruity between the teacher identity's standard and the feedback may be addressed in several ways. Selective interaction may allow the teacher to avoid students that give bad reviews. The teacher may choose to display identity cues to indicate the quality of their teaching, such as past awards or positive feedback. The teacher may also alter behavior in an attempt to prompt verifying feedback from those who had given the disconfirming feedback. It is also possible that the teacher may pay selective attention to confirmatory feedback, even selectively remembering confirmatory feedback rather than disconfirmatory feedback. Finally, the teacher may choose to selectively interpret the bad review, justifying it as "not really that bad." In each of these ways, the perception that one's identity has been disconfirmed has resulted in behavior that confirms or verifies the identity.

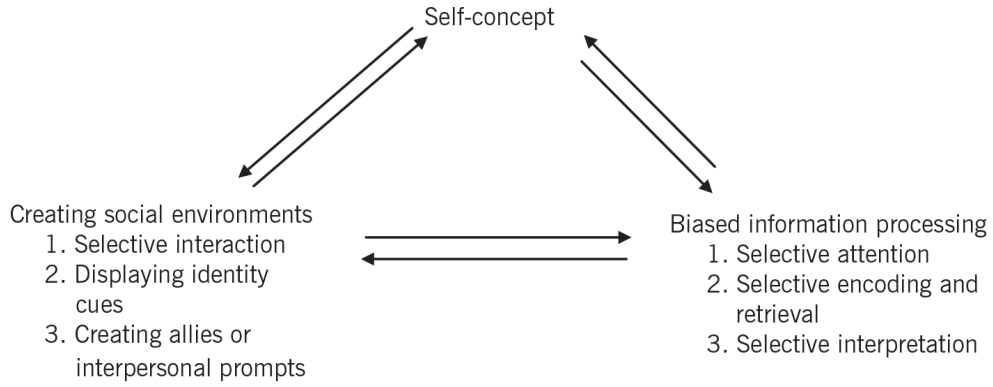

Figure 3.2. Self-verification Process (Swann & Buhrmester, 2012, p. 408)

Since they are relatively stable, identities act a framework through which individuals can predict the way others react to their behavior. When individuals interact, it's never two whole selves interacting, but rather it's an interaction of salient identities (Burke & Stets, 2009). In a classroom, the interactions are governed by the expectations of a teacher interacting with students. A specific situation, perhaps the discussion of a topic of particular importance to a student, may bring a non-student identity into prominence. While potentially a positive experience, this situation may also lead to unexpected behavior that challenges the expected social norms of a teacher-student interaction. "People strive to avoid such disasters by entering into and creating social worlds that confirm their self-views" (Swann & Buhrmester, 2012, p. 407).

Identities tend to be classified into one of four types. Most heavily analyzed in sociological approaches to identity are role identities, which internalize society's expectations for individuals acting in a given societal role (Burke & Stets, 2009). "Educator," "worker," and "parent" are all examples of role identities and may even all be part of a single individual's self-concept. Group identities, which are the focus of research in psychology, serve a similar function for members of groups (Burke & Stets, 2009), including religious, ethnic, and cultural groups. Person identities are those that attempt to distinguish one as a unique individual (Burke & Stets, 2009). "Trustworthy," "frugal," and "artistic" are all examples of person identities. More recently, researchers, particularly in the domain of consumer research, have explored material identities, tied to possessions or places (Clayton & Opotow, 2003; Dittmar, 2008; Tian & Belk, 2005). Material identities, which are constructed and function like role, group, and person identities, refer to self-identification with most any physical or conceptual thing or class of things: A theoretical framework, a make of car, or a software package.

Historically, the IT literature tends to look at the relationship between technology use and identity in three ways: technology use can be a *medium* for identity, *determinant* of identity, and *consequent* of identity. As a medium for identity, it allows us to express an identity: A graphics application may allow an artist to express themselves through their digital creations. As a determinant of identity, technology use is seen to change existing identities or bring about new identities: An individual in the 1980s who gained access to a modem may have developed a telecommuter identity. As a consequent, technology use driven by our other social roles may give rise to new identities or bring about changes in old ones: A teacher may begin to use new technologies as a consequence of verifying their teacher identity, should part of its standard involve keeping current with new teaching techniques (Carter & Grover, 2015). None of these historic approaches to identity and IT explore self-identification with the IT itself.

Recent research has theorized an IT identity, defining it as "the extent to which an individual views use of an IT as integral to his or her sense of self" (Carter & Grover, 2015, p. 932). Understanding IT identity is fundamental to understanding how individuals interact with technology on a day-to-day basis, both at work and in their personal lives. It was originally conceived to explain phenomena involving the use and adoption of consumer technologies. An IT identity is theorized in three dimensions: *relatedness*, *emotional energy*, and *dependence*. People having an IT identity will feel that they are connected to IT; experience sensations of "confidence, enthusiasm, and energy" (Carter & Grover, 2015, p. 945) when considering IT; and believe that they can rely upon IT to help them in their work and personal lives. Users exhibiting their IT identities will have comparatively higher levels of use, seek out ways to use the IT and explore additional affordances of the IT, and resist replacing it with new, different technology.

IT identity was originally conceived as a new form of material identity, encompassing technology at many levels (Carter & Grover, 2015). As defined, IT identity applies to an "an IT," but identities can be complex and overlapping. An IT identity may be with a class of devices, a device, an operating system, an application, or a function of an application. In the same way, game-related identities may exist at the level of a platform, a device, a game genre, a game franchise, a specific game, or a game mechanic.

IT identity was also conceived as a positive self-identification with an IT (Carter & Grover, 2015), running in strength from indifference ("this has nothing to do with who I am") to positive identification ("this is who I am") rather from negative identification ("this is antithetical to who I

am") to positive identification. Further investigation explored negative identification, and has suggested that our complex relationships with IT may be theorized in two dimensions, including indicators of both positive and negative self-identification with IT. The resulting grid includes positive and negative self-identification as well as dis-identification and ambivalent self-identification (Carter et al., 2018).

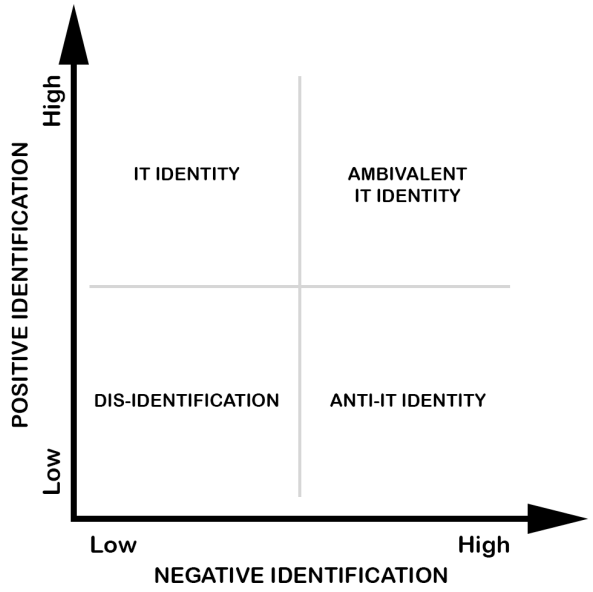

Figure 3.3. Identification Quadrants (Carter et al., 2018, p. 5)

IT identities are independent of expertise or self-efficacy with an IT: A person can be an expert with a given technology, feel capable of using that technology, and also feel it has little to do with who they are (dis-identification) or even that it is antithetical to who they are (anti-identification) (Carter et al., 2018). For example, a competent MacOS user may feel that OS is antithetical to who they are, while perhaps having a positive IT identity involving Windows or a flavor of Linux.

In the IT identity theoretical model (Carter & Grover, 2015), an IT identity influences behavior, and that influence is moderated by a set of Situational Influences which include Opportunities and Support (which incorporates training, policies, infrastructure, interpersonal ties, and technological ties), Perceived Behavioral Control ("the extent to which a person feels able to enact the behavior in accordance with an IT identity" (p. 944)), and IT Dynamism (the frequency and extent of changes to the technology).

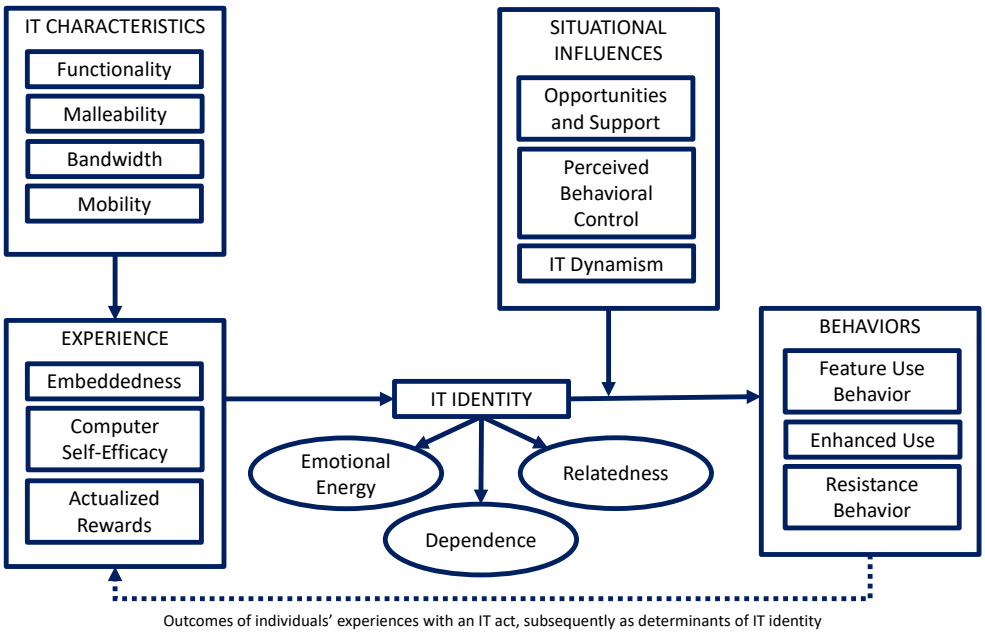

Figure 3.4. Initial Theoretical Model for IT Identity (Carter & Grover, 2015, p 943)

3.1.2 *Psychological Ownership*

Psychological ownership is conceptually related to self-identification with an object but is not synonymous. Material identities concern who a person is in relationship to an object while psychological ownership concerns a person's feelings of possessiveness towards an object. It is also not synonymous with legal ownership, as a person can have feelings of possessiveness towards objects they do not own, including immaterial objects such as "ideas, words, artistic creations, and other people" (Pierce, Kostova, & Dirks, 2003, p. 4).

In the domain of psychology, psychological ownership is thought to have its roots "in three human motives: (a) efficacy and effectance, (b) self-identity, and (c) 'having a place'" (Pierce et al., 2003, p. 8). Efficacy and effectance refers to the human motivation to feel a sense of control over their environment, and having a place refers to the human motivation to have personal space that provides a sense of security. The basic motivations of maintaining a sense of self are detailed above, and illustrate the strongest conceptual connection between material identities and psychological ownership. "Ownership may emerge as the result of any one, or any subset, of these needs. For example, an individual may feel ownership when he/she has a strong efficacy and effectance motive, even though the identity motive might be non-active" (Pierce et al., 2003, p.

21). These motives are not entirely independent of one another: Satisfying any one of them has the potential to reinforce the others.

There are also three theorized paths (or mechanisms) that give rise to psychological ownership: controlling the ownership target, coming to intimately know the ownership target, and investing the self into the ownership target. Pierce suggests "that the three routes to psychological ownership… are distinct, complementary and additive in nature. Any single route can result in feelings of ownership independent of the others. However, the feelings of ownership for a particular target will be stronger when an individual arrives at this state as a result of traveling multiple routes… rather than just one route" (Pierce et al., 2003, p. 21).

Recent IT identity scholarship suggests that psychological ownership is a consequent of IT identity. "Self-identification with a material object can give rise to psychological ownership… [implying] that as a person reflects upon and positively self-identifies with use of an IT, s/he may begin to experience a sense of ownership over the technology" (Carter et al., 2020).

3.2 Existing Indicators for IT Identity

Carter and Grover (2015) theorize IT identity as a higher order construct operationalized by three factors taken primarily from environmental identity literature: *relatedness*, *dependence*, and *emotional energy* (see Figure 3.4).

"Emotional energy refers to a person's enduring feelings of emotional attachment and enthusiasm in relation to an IT [...and] represents individuals' feelings of confidence, enthusiasm, and energy when thinking of themselves in relation to IT" (Carter & Grover, 2015 p. 945). When examining dis-identification with IT, Carter et al., 2020 used a set of terms including the following: hostile, irritated, upset, diminished, drained, and threatened. Individuals who anti-identify with technology may also feel confident, enthusiastic, or energized when distanced from IT.

While dependence may have a negative connotation in some domains, here it indicates a person's positive belief that they can rely upon the functionality of the IT (Carter & Grover 2015). By extension, we expect individuals anti-identifying with IT may feel that they cannot rely on technology, may feel threatened by its presence in their lives, or may express a desire to distance themselves from it. Individuals who dis-identify with IT will not rely heavily on technology but will also not try to avoid any reliance upon it.

Relatedness represents an individual's feelings that the IT is part of their extended self, "blurring [...] boundaries between the self and an IT, and [manifesting] as feelings of connectedness" (Carter & Grover 2015 p. 945). The affordances of the IT may come to be perceived as part of the individual's own abilities. An individual who strongly relates to IT may feel less like themselves when deprived of it. Individuals who dis-identify will have no feelings of relatedness while an individual who anti-identifies may feel the IT is alien or antithetical to themself (Carter et al., 2020)

Subsequent investigations have produced a set of indicators regarding each of these dimensions of IT identity (Carter et al., 2020):

- **Dependence**
  - Thinking about myself in relation to (MS Excel/my smartphone), I am reliant on [the IT].
  - Thinking about myself in relation to (MS Excel/my smartphone), I am dependent on [the IT].
  - Thinking about myself in relation to (MS Excel/my smartphone), I am counting on [the IT].
- **Emotional energy**
  - Thinking about myself in relation to [the IT], I feel energized.
  - Thinking about myself in relation to [the IT], I feel pumped up.
  - Thinking about myself in relation to [the IT], I feel enthusiastic.
- **Relatedness**
  - Thinking about myself in relation to [the IT], I am in coordination with [the IT].
  - Thinking about myself in relation to [the IT], I am linked with [the IT].
  - Thinking about myself in relation to [the IT], I am connected with [the IT].

Each measure is expressed on a seven-point Likert scale with the following range of possible responses: strongly disagree, disagree, somewhat disagree, neutral, somewhat agree, agree, or strongly agree.

Researchers developed these indicators by asking participants to reflect on their feelings towards one of two commercial consumer technologies: Excel and smartphones, which are in contrast. Excel represents an older, relatively stable form of technology while smartphones are newer and can change rapidly through additional software features or the acquisition of new apps.

These indicators do not seem to be fully functional in relation to technology under development. While a project team member may feel emotional energy and relatedness when considering the IT under development by their team, the reliance dimension fails a test of face validity. While it may be possible for a team member to rely upon work-for-pay associated with the technology, the original intent is that users rely on functionality of an IT. In early phases, there may not even be functional builds of software in development, so it stands to reason that if project team members are forming identities involving the technology under development, it is not because they can rely on its features. To better understand the potential dimensions of IT identity in project team members, we turn to research into the identity-related functions of material objects.

3.3 Identity-Related Functions of Material Objects

The study of self-identification with material objects is more prominent in marketing and consumer studies than in MIS. Dittmar's (2008) report of material and consumer identities theorizes a set of identity-related functions of material objects (*identity functions* herein)—focusing on consumer goods—presenting an alternative conceptualization of the dimensions of a material identity. According to this framework, material objects can serve seven identity functions. This work strongly references theory regarding human motivation for creating and maintaining identities—identity motives (Vignoles, 2011)—by tying identity functions to identity motives (see Table 3.1).

Table 3.1. Relationship between Identity Functions and Identity Motives (Dittmar, 2011)

Identity Function	**Linked Identity Motive(s)**
Effectiveness	Self-efficacy
Emotional regulation	*None*
Actual identity	Distinctiveness; Continuity
Ideal identity	Self-esteem
Personal history	Continuity
Symbolic interrelatedness	Belongingness
Social identity	Belongingness
None	Meaning

3.3.1 *Effectiveness*

As an identity function of material goods, effectiveness regards feelings of control and mastery, either over the object or afforded by the object over other people or things. It can be found when participants share "accounts of how their material possessions enable them to do specific activities

and enhance their independence, freedom, and autonomy". It is tied to self-efficacy, "the belief that one has the capability to perform a particular behavior" (Compeau & Higgins, 1995). Obviously, an individual can both over- and under-estimate their actual capabilities with technology.

A material object can give individuals a sense of control directly as they show proficiency with it and mastery over it. It can also afford control and mastery over an individual's environment (physical and social) and afford a sense of independence or autonomy through its use. "The magnitude of control an individual has over their possessions is of the same order as the control they exert over their body, and it is this powerful control, which leads to possessions becoming a part of people's sense of self" (Dittmar 2011, p. 750). The effectiveness function is related to self-efficacy identity motive. Identity motives may also drive an individual away from a material object that makes them feel less competent, causing them to develop a dis-identification or anti-identification with the object.

We expect that this effectiveness function will be seen with work-related objects, including tools. Whether the tool is a hammer or an integrated development environment (IDE), we may find that the individuals using them self-identify with them due to the control they provide over the work. The work product may also be imbued with this meaning, as a symbol of the mastery the individual has been able to achieve with the tools.

3.3.2 *Emotional Regulation*

A material object can help an individual regulate or enhance their mood, and offer a sense of comfort or security. "Individuals use material goods to express, regulate or enhance their mood, find emotional comfort, derive a sense of emotional security, vent their frustration, or escape from unwanted emotional states." Children's toys are often said to have this function.

Sometimes, the act of consumption is seen as the source of this function rather than any specific item consumed. In this way, emotional regulation through material goods may have drawbacks as well as the emotional benefits (Dittmar, 2011). For example, attempts to regulate one's emotional state through consumer behavior can have obvious financial drawbacks, and hoarding behavior is often seen as problematic. In the same way, we expect that work on a product that provides a form of emotional benefit—either through work on the product or through use of the product—may also have detrimental effects for the worker (and beneficial effects for

management) such as a willingness to work for less than market rates or to work extended hours for long periods of time.

Since studies have shown that utilitarian and hedonic shopping motives are distinct (Babin, Darden, & Griffin, 1994), and that product review evaluation behavior varies between utilitarian and hedonic product reviews (Schmalz et al., 2019), it follows that the nature and intensity of emotional responses to products during development may also differ along this spectrum.

The emotional regulation function is not specifically related to any identity motive.

3.3.3 *Actual Identity*

Dittmar describes the actual identity function in terms strongly related to person identities: "A material object affords an individual an opportunity to show who they are as an individual and differentiate themselves from others. Material objects can serve to display 'an individual's unique qualities, values, and personal goals, expressing their personal identity and their differentiation from others' (Dittmar, 2011 p. 751). However, objects obviously serve this function for role identities, showing who an individual is in a societal role (e.g. a doctor who self-identifies with a stethoscope as a symbol of their societal role as physician). Below, we will also consider the social identity function as a parallel to the actual identity function, but for group identities. The actual identity function is related to the distinctiveness and continuity identity motives.

3.3.4 *Ideal Identity*

Material objects also allow individuals to express an aspirational self. An individual who "dresses for the job they want rather than the job they have" may be exhibiting this function, using clothing to express an idealized self. This function also includes identity repair through the acquisition of consumer goods for self-verification following a perceived imbalance in an actual identity. This ideal expression of identity can also be fantastic in nature, either knowingly or because the individual may not know whether an ideal identity is fantastic or not. The ideal identity function is related to the self-esteem identity motive.

Since software projects are, by nature, future-looking, it follows that individuals on software teams may use participation in projects to pursue ideal identities. For some, this pursuit may be through the acquisition of new skills in order to better contribute to the product. Similarly, the product may represent an opportunity for personal advancement in pursuit of an ideal role in

the organization or industry. For others, contributions to innovative features may serve this function: Work toward an idealized product may serve as a proxy for pursuit of an idealized self.

3.3.5 *Personal History*

A material object can link an individual to their past and provide a sense of continuity of self. Any cherished trophy, souvenir, or memento serves this identity function, and feelings of nostalgia can serve as indicators of a personal history function.

Objects can also be reminders of abandoned identities or provide a sense of continuity with a long-standing identity. The personal history function is related to the continuity identity motive.

3.3.6 *Symbolic Interrelatedness*

A material object can be a representation of a relationship with another individual, particularly when that other individual is not present. For example, a wedding ring is symbolic of a relationship with one's spouse, and a family heirloom may represent a connection to the ancestor who acquired or crafted it. Where many identity functions are served by active acquisition of a material object, the symbolic interrelatedness function is often initiated through the giving of an object, as the recipient associates the object with the gift-giver. The symbolic interrelatedness function is related to the belongingness identity motive.

3.3.7 *Social Identity*

A material object can represent membership or status in a social group or subculture. Perhaps this is most easily illustrated with a sports enthusiast who acquires clothing and other objects to show their membership in the team's fandom.

The social identity function is also related to the belongingness identity motive, like the symbolic interrelatedness function.

3.3.8 *Meaning*

Meaning is not an identity function, but is rather the only identity motive not related to an identity function. In a very real way, identity theory is all about meaning-making. The meaning motive is narrower, being the human motive to create and maintain identities so that they can feel "that their lives are meaningful" (Vignoles, 2011, p. 403), involving "the need to find significance or purpose

in one's existence (Vignoles, 2011, p. 417 summarizing Baumeister, 1991). So while structural symbolic interactionism can include understanding the shared meaning of a societal role ("plumber"), not all humans are motivated to find individual purpose in those symbols (serving a rewarding role as a plumber).

3.4 THE IKEA EFFECT

While there is little literature available on the effect of creative acts on self-identification with the objects being created, Norton et al. (2012) use a popular brand of build-it-yourself home furnishings to name their theories regarding the effect of labor on the valuation of material goods. Experiments show that participants increase their valuation of an object if they contributed labor to its construction.

One experiment into the IKEA effect involved asking two groups to suggest a value for the same product–a box–with one group purchasing a pre-assembled version and the other assembling the product themselves. "[The individuals] who assembled their own box were willing to pay a 63% premium compared to those who were given the chance to buy an identical preassembled box" (Norton et al., 2011, p. 455). Another experiment used folded paper objects, and found that "builders valued their origami so highly they were willing to pay nearly as much for their own creations as the additional set of non-builders were willing to pay for the well-crafted origami made by our experts" (Norton et al., 2011, p. 456). Valuation of pre-built items were consistently lower than valuation of the same item when personal labor was involved.

Experiments with the box and origami both involved completed objects, but experiments were also conducted on partially assembled objects and assembled-and-disassembled objects to see if completion of construction had an impact on valuation. "Those who were given the chance to complete their creation imbued it with significantly more value—and were willing to pay more than twice as much to keep it" (Norton et al., 2011, p. 458). This result is used as a basis to suggest that the success of one's labor is an important factor in the valuation of the resulting product.

These experiments focused on objects which took a very short time to build and whose "success" state was easy to judge. The effect may be significantly different for a long-term project during which it is not easy to assess whether or not one's labor is leading to success, and where success is not as easily measured as the completion of a box, origami, or small LEGO set. While

not directly tested, the research theorizes that the type of object being built may also moderate its valuation:

> "[We] suggest that the role of these factors is likely to vary by the type of product being assembled. For instance, compared to origami and Legos, the boring, utilitarian IKEA boxes [...] are unlikely to prompt deep emotional attachment, and offer little opportunity for bragging rights; indeed, the social utility gained from displaying products decreases as product complexity decreases" (Norton et al., 2011, p. 259).

3.5 Research Model

This work explores the way self-identification with technology affects work-based risk behaviors using identity theories as a theoretical foundation. Existing models of identity and behavior may be insufficient due to the distinctive traits of the project context, while project management and software research tends to treat workers as collections of skills rather than as individuals, each with a complex sense of self. While the IT identity theoretical model is based on identity theories involving material identities, it is primarily a model to explain adoption and use, not creation. We require a new model to consider phenomena related to individual worker behavior when the individual self-identifies with the technology they are creating. This work proposes to explore such a model (see Figure 3.5).

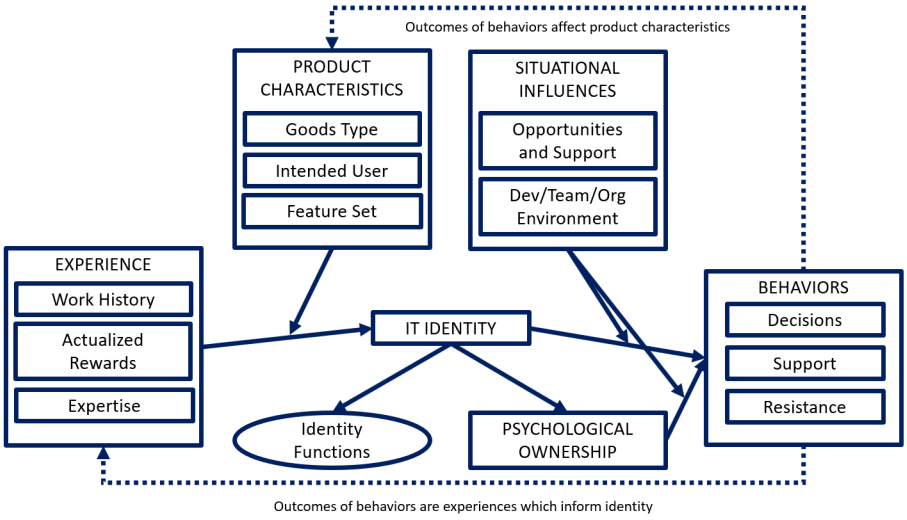

Figure 3.5. Theoretical Model for IT Identity and Development Team Members

In this model, a worker's Experience with related technologies influences the formation of an IT identity regarding a new IT they share in creating. One cannot form an identity around something one has never experienced in some fashion. For workers participating from the start in the creation of new technology, we look to their experiences with related technologies which will influence early identity formation. Since this study is focused on development team behaviors, past technology experiences may include a history of past projects, expertise in the form of technological skills and knowledge, and perceived rewards from the use or creation of similar technologies. It is also possible that a worker is introduced to a team responsible for ongoing development of a working technology, in which case these factors can actually include experiences directly with the IT under development.

The process is moderated by the characteristics of the product under development (Product Characteristics). These characteristics can be both current and planned, and can even change due to the development process. A product's Goods Type is an expression of its presence on a continuum of its cultural meaning. While this continuum is theorized as ranging from purely utilitarian to consumerized to highly cultural, exact measurement of this construct is beyond the scope of this work. Further moderating the process is the worker's perception regarding their closeness to the product's target user, which may involve other types of identities. Finally the product's current and planned feature set will influence the worker's self-identification with it.

This theoretical model includes Psychological Ownership as a consequent of IT identity, consistent with recent IT identity research. Self-identification with a technology creates a sense of Psychological Ownership of it, and these two drive work Behaviors. These behaviors include work decisions as well as non-decision behaviors which may support or resist the effective functioning of the project team. The outcomes of work behaviors (for example, the manner in which the behavior is rewarded or resisted) are experiences themselves, influencing the worker's self-identification with the IT under development.

The influence of the IT identity and psychological ownership on behaviors is moderated by Situational Influences. Opportunities and Support comprise a set of organizational policies or features which an individual might perceive to grant opportunities for enacting an IT identity and support for doing so. Carter & Grover (2015) include training, policies, infrastructure, interpersonal ties, and technological ties in their original model, but this list may change in the

development context. Another situational influence is the nature of the dev team and the organization, and their perceived tendencies to reward or resist the enacting behaviors. This is an expression of the culture in which the IT is being developed, and is expected to involve worker identification with those groups. Table 1 summarizes these constructs.

Table 3.2. Constructs

Category	**Construct**	**Definition**
Behaviors	Decisions	Project-related decision-making behaviors which impact development plans and may involve risk.
	Support	Behaviors which support current development plans of project/org leadership.
	Resistance	Behaviors which resist current development plans of project/org leadership.
Experience	Work History	Related work on similar projects.
	Actualized Rewards	Benefits/Rewards/Satisfaction with products similar to project outcomes.
	Expertise	Skills and knowledge applicable to the work performance and the use of the final product.
Product Characteristics	Goods Type	A continuum regarding the cultural meaning embodied by the product ranging from Cultural to Consumerized to Utilitarian.
	Intended User	Perceived similarity between worker and the target user.
	Feature Set	The current specification.
Situational Influences	Opportunities and Support	Perceived opportunity and support for enacting the IT identity (possibly including training, policies, infrastructure, interpersonal ties, and technological ties) (Carter & Grover, 2015)
	Dev/Team/Org Environment	Work environment traits (may involve group identities for worker)

Behaviors driven by self-identification with the product must either support the current set of characteristics or alter them. I expect to find a self-confirmatory decision-making behavior where IT identities are salient: Workers who self-identify with the technology will tend to make

decisions that move the product characteristics closer to their ideal. In the established identity thermostat metaphor, our behavior corrects for perceived imbalances between the way we think we are perceived and our identity standard, but here the perceived imbalance involves the tech we are developing, too.

As with all models, this is an abstraction to help better explain the mechanisms behind phenomena. The research is not intended to simply verify or refute this model, but to use it as a starting point to develop an improved model that represents a greater understanding of these constructs and their interactions.

3.6 SUMMARY

This research project was conducted within a framework of structural symbolic interactionist theories regarding identity, particularly IT identity. These identity theories can help us better understand product team behavior, but are currently unused in the domain. This research will use these identity theories, particularly IT identity, to explore and test a new theoretical model for IT identity in the IT development context.

In the following section, we will look at the specific methods for this investigation into the sources of project worker risk behavior, particularly as they apply to self-identification with the product under development.

Chapter 4. METHODS

This mixed-methods research involves the development of a new measurement model for self-identification with technology and a larger survey to evaluate it. In addition to the use of structural equation modeling (SEM) methods, open-ended survey results were also analyzed qualitatively to better understand both dependent and independent variables used. This chapter explains each method used for the construction of data-gathering instruments and evaluation of their results, as well as the means of recruiting participants for the project.

This work took place during the COVID-19 pandemic, and the research design represented here was an alteration of a pre-pandemic design. That original design was primarily a qualitative research project involving a carefully chosen pair of internally replicating case studies of project teams and their members, one case utilitarian in nature and the other cultural. In order to emphasize the distinction between cultural and utilitarian products, the cultural product would have been a publicly published digital game and the utilitarian products would have been a management information system intended only for use within a single organization or a B2B software product or service where the development team is unlikely to consider themselves part of their own target market. While the cases would have encompassed a project team, the unit of analysis would have been the individual since identity theories involve individual construction of a sense of self.

Data collection in the original design involved a Twenty Statements Test (TST) (Kuhn & McPartland, 1954). a short survey, and a semi-structured critical decision (Klein, Calderwood, & MacGregor, 1989) interview. Secondarily, participants were to be asked to provide access to any work-related documents or other artifacts they feel may contribute to understanding their decision-making process. Observation of the participants' representation of themselves within their work environment would also provide data. This data would be qualitatively analyzed to identify workplace identities and the manner in which workplace identities, development decisions, and the relationships connecting the two. From these results, a survey would be created to verify findings among a larger population of software development professionals.

During COVID-19, on-site interviews became impossible, and a new research design evolved. In this new design, the focus is on creating and testing a measurement model for a worker's self-identification with the technology they were creating, and the primary data-gathering method became the survey. Where the original design may have produced a set of IT identity

indicators based on the findings of its qualitative analysis, the pandemic research instead involves constructing indicators based on published theory regarding identity functions, partially informed by personal experience within the industry. Development of the measurement model is based on structural equation modeling (SEM), which is an established set of quantitative methods for such work in the social sciences (Hair et al., 2022). Since the target population is software professionals—who can be expensive to recruit for long surveys—efforts were made to reduce the full cost of the work by breaking it down into less time-consuming, expensive tasks for professionals and performing face validity tests with Ph.D. student populations to remove the need for extensive iterative work with expensive populations. Open-ended survey questions were constructed to gather an approximation of the qualitative data that would have originally been gathered during case studies. While the results of an open-ended survey question may never be as rich as the data gathered through semi-structured interviews and field observation, these questions do serve the original purpose of gathering details of actual user experience that fall outside the constraints of multiple choice and Likert scale questions. Existing instruments for measuring IT identity were integrated for the sake of comparison, aimed both at the product under development and IT in general. Each method is explained below, as well as their relative order during the project.

4.1 Ontological Approach

This research is being performed from a post-positivist critical realist perspective. This ontological perspective "holds that an (objective) world exists independently of people's perceptions, language, or imagination. It also recognizes that part of that work consists of subjective interpretations which influence the ways in which it is perceived and experienced" (Edwards, O'Mahoney, & Vincent, 2014, p. 2). In that regard, the phenomena regarding self-identification with technology are seen as an objective part of our reality, but our understanding of these phenomena are imperfectly understood due to subjective interpretations of them. The goal, then, is to use research methods to bring our subjective understanding closer to the objective reality. In this research, this goal is accomplished by proposing a theoretical model and a measurement model based on theory and testing them through mixed-methods analysis of survey data from people who directly experience the phenomena (Edwards et al., 2014).

In this fashion, gathered data will be used to test the fit of the research model (see Figure 3.4). That model is extensive, so this work is not expected to evaluate it in its entirety, but rather to

explore the relationships that emerge. Focus is given to a subset of relationships: IT Identity, Identity Functions, and Behaviors portions of the model. If any data falsifies the model, the model will be revised and analysis performed iteratively until the model matches the evidence.

4.2 Development of Measurement Model

As mentioned above, the prior accepted indicators of IT identity can be interpreted to lack face validity when applied to the self-identification of technology creators with their creations. To identify a more inclusive set of indicators, I focused on identity-related functions of material goods (Dittmar, 2011), theorizing that the strength and number of active identity-related functions a person experienced towards a material (in this case, the product they are working on) will serve as an indicator of the strength of the underlying self-identification with that material.

The building of an alternative IT identity model was a multi-stage, iterative process that primarily utilized two methods: card sorts and structural equation modeling.

4.2.1 *Card Sorting*

Psychologists developed early card sorting practices to elicit information about how "people organize and categorize their knowledge" (Wood & Wood, 2008). A card sorting activity often begins with a literal set of cards, each with a concept for the participant to organize. In an open sort, the participant sorts concepts into piles representing categories, and then names the categories. In a closed sort, the categories have already been determined by the researcher, and the participant sorts the cards into those pre-ordained categories (or, colloquially, "buckets"). For example, a software user interface researcher might create a set of cards representing user tasks and have a set of participants sort them conceptually in an attempt to determine the best organization of toolbars. Participants may be asked to voice their logic during the sort, allowing researchers better understanding of the logic behind participant decisions. There are many other variations on specific techniques used, but all involve the same fundamental grouping of concepts into categories.

In practical terms, the card sorts were performed synchronously via teleconferencing software and an online survey hosted by Qualtrics, a survey platform that also offers participant recruitment services. (For the model creation process, Qualtrics's participant recruitment services were not used.) While Qualtrics has a card sort question type, its design was seen to work best for

cards with very little text, and the specific nature of this sort (with each card including the full text of a question intended as a candidate indicators) precluded its use. Instead, users were presented with a matrix table, with rows representing candidate indicators and each column representing an identity-related function of material objects. Participants selected the radio button corresponding to the identity-related function to which they believed the candidate measure corresponded. Qualtrics randomized the order of candidate indicators as presented to participants to hide the patterns inherent in the survey construction. Results could be viewed showing all responses for each candidate measure, allowing me to see where participant interpretation of the question matched my intent.

4.2.2 *Structural Equation Modeling*

Structural Equation Modeling (SEM) is a collection of methods for multivariate analysis. Broadly, SEM processes involve the creation and testing of mathematical models regarding the interaction of dependent and independent variables (Hair et al., 2022). Among the many methods under the SEM umbrella, this work uses factor analysis (FA) and partial least squares (PLS-SEM) techniques.

Techniques related to FA seek efficient ways to use practical, observable indicators to estimate the value of something that is not directly measurable (a latent variable). For example, the individual often credited as developing factor analysis was attempting to find a relationship between test results (a practical, observable measure) and intelligence (a latent variable, not directly measurable) (Bollen, 1989).

Factor analysis allows statistical analysis of sample indicators for the purpose of finding efficient means of estimating latent variables, seeking a small number of indicators which have the most explanatory power for a given latent variable. Originally, it was developed “to explain the relationship between a number of observed variables in terms of a single latent variable” (Bollen 1989, p. 226), though advances in related techniques allow for multifactor analysis dealing with multiple latent variables. The primary goal is to explain the covariances or correlations between many observed variables by means of relatively few underlying latent variables” (Bollen 1989, p. 226). “Factor analysis can transform a collection of highly correlated explanatory variables that are indicators of the same type to one or two factors having nearly as much predictive power regarding the response variable” (Agresti & Finlay, p. 630).

There are two basic forms of factor analysis: confirmatory (CFA) and exploratory (EFA). CFA is performed when attempting to verify a pre-determined model of observable indicators and latent variables. EFA uses covariance in a set of observable variables in order to identify underlying latent variables. While Dittmar's identity-related functions of material objects were pre-chosen as latent variables, the objective of the research is to identify observable indicators for each. This is an exploratory use of FA techniques.

During early instrument development, analysis consisted of a combination of functions in IBM SPSS Statistics 28 (IBM Corp., 2020). The process was a combination of using the RELIABILITY command to test the cohesiveness of sets of indicators intended for a single latent variable and FACTOR commands on candidate indicators for multiple latent variables.

As part of its output, the SPSS RELIABILITY test produces a measure of cohesiveness called coefficient alpha, or Chronbach's alpha. Values for coefficient alpha are continuous decimal values between 0 and 1, with numbers closer to 1 indicating greater cohesiveness of the indicators.

```
RELIABILITY
  /VARIABLES=EFF1 EFF2 EFF3 EFF4 EFF5
  /SCALE('EFF_CA') ALL
  /MODEL=ALPHA
  /STATISTICS=DESCRIPTIVE SCALE CORR
  /SUMMARY=TOTAL MEANS CORR.
```

Figure 4.1. Sample RELIABILITY Command in SPSS

The guidelines in Table 4.3 were used for evaluating coefficient alpha scores (Hair et al., 2022; Wong 2019). While scores under 0.70 are sometimes considered unacceptable, Wong (2019) shares that Hulland (1999) allows for scores as low as 0.40 in exploratory research.

Table 4.3. Coefficient Alpha Evaluation Criteria

Score	**Evaluation**
≥ 0.70	Acceptable
0.40– 0.70	Conditionally Acceptable
<0.40	Unacceptable

RELIABILITY output can also include a table named "Item-Total Statistics". This table includes two columns utilized during the refinement of factors: "Cronbach's Alpha if Deleted" and

"Squared Multiple Correlation". If analysis showed that coefficient alpha would be increased if a candidate measure was removed from analysis, it was removed. (For example, the item labeled EFF-Demonstrate-Competence in Figure 4.2 shows that its removal would increase coefficient alpha from .810 to .842, so the item would be removed from consideration, the RELIABILITY command can be re-run without that candidate measure, and analysis can continue.) If analysis showed that coefficient alpha would take a very small drop in coefficient alpha if removed, it was also removed since removal of a measure was considered a greater benefit than a small improvement in coefficient alpha. Low squared multiple correlation scores were considered additional evidence for removal of a candidate measure from consideration. For each latent variable, three indicators were sought using these iterative techniques.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.810	.817	5

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
EFF-Control	8.5822	9.624	.656	.508	.754
EFF-Important-Decisions	8.6712	9.215	.667	.572	.750
EFF-Good-Decisions	8.8356	9.890	.747	.567	.732
EFF-Demonstrate-Competence	8.4110	10.975	.380	.226	.842
EFF-Skills	9.0342	10.764	.592	.395	.776

Figure 4.2. Sample RELIABILITY Output in SPSS

FACTOR tests were run to test candidate indicators across latent variables. Since all candidate indicators were expected to covary in some fashion, FACTOR tests allowed me to see if variables that tested reliably as indicators for their intended latent variable were inappropriately cross-loading into other latent variables, limiting their utility for their intended latent variable. These tests were executed with one of two CRITERIA options, situationally: MINEIGEN() and FACTORS(). MINEIGEN() takes a single numeric parameter and identifies factors based on that minimum eigenvalue, where an eigenvalue of 1 or greater means that a set of indicators have greater explanatory power of a latent variable as a group than as individual indicators. Using FACTOR with the FACTORS criterion will produce a specified number of factors regardless of their eigenvalues. In Figure 4.3, the sample FACTOR command uses the MINEIGEN(1) CRITERIA to identify all factors above the eigenvalue threshold of 1. The FORMAT option

BLANK(.30) will produce output that does not display weak correlations (below .3) to reduce visual noise in one of the resulting tables.

```
FACTOR
/VARIABLES AID1 AID3 AID4 AID7 IID3 IID4 IID5 SID1 SID3 SID4 PRH1 PRH3 PRH4
 /MISSING LISTWISE
 /ANALYSIS AID1 AID3 AID4 AID7 IID3 IID4 IID5  SID1 SID3 SID4 PRH1 PRH3 PRH4
 /PRINT UNIVARIATE INITIAL CORRELATION SIG KMO EXTRACTION ROTATION FSCORE
 /FORMAT SORT BLANK(.30)
 /CRITERIA MINEIGEN(1) ITERATE(25)
 /EXTRACTION ML
 /CRITERIA ITERATE(25)
 /ROTATION PROMAX(4).
```

Figure 4.3. Sample FACTOR Command in SPSS

Analysis of FACTOR test results includes Bartlet's Test of Sphericity, a correlation matrix of all variables, a Total Variance Explained table that reports the variance explained by each identified latent variable, and a Pattern Matrix table which shows is particularly useful for analyzing patterns in the identified factors.

Bartlet's Test of Sphericity is a method of determining if the candidate indicators being analyzed are appropriate for reduction into latent variables. If the candidate variables were uncorrelated, the result would appear as an identity matrix. Since factor analysis is searching for correlated factors, Bartlet's Test of Sphericity is used to ensure that the factors are correlated in a statistically significant way and therefore suitable for reduction into latent variables. The results of the test include a p-value which is an expression of the likelihood that the correlation matrix of the data set is not the same as the identity matrix. If the p-value is appropriately low (depending on the needs of the particular analysis) then further analysis should be meaningful (Zach, 2019).

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.907
Bartlett's Test of Sphericity	Approx. Chi-Square	1143.500
	df	78
	Sig.	<.001

Figure 4.4. Sample FACTOR Output for Bartlett's Test of Sphericity in SPSS

The correlation matrix shows the correlation between each pair of observable variables. The diagonal in the table is the pairing of each variable with itself, so these will be perfectly correlated (and have a value of 1). The correlation matrix is symmetrical along this diagonal since

the upper and lower halves are mirrors (the correlation between variables A and B is the same as the correlation between B and A), so some expressions of a correlation matrix will only include half of the matrix. In the resulting matrix, groups of candidate indicators intended for a common latent variable should correlate strongly with each other and weakly with the other indicators.

The Total Variance Explained table is a summary of the identified factors. The report includes data on eigenvalues of the identified factors as well as the percentage of variance in the data explained by the factor, showing their relative explanatory strength. In Figure 4.5, the sample illustrates the identification of three factors which cumulatively explain 71.213% of the variance in the data.

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
Factor	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	6.504	50.032	50.032	5.968	45.906	45.906	5.653
2	1.494	11.493	61.525	1.327	10.211	56.117	4.361
3	1.259	9.688	71.213	.921	7.088	63.205	3.221
4	.667	5.131	76.343				
5	.586	4.510	80.854				
6	.465	3.581	84.434				
7	.415	3.195	87.629				
8	.361	2.780	90.408				
9	.337	2.590	92.999				
10	.277	2.132	95.130				
11	.250	1.927	97.057				
12	.217	1.668	98.724				
13	.166	1.276	100.000				

Figure 4.5. Sample FACTOR Output for Total Variance Explained in SPSS

The pattern matrix includes a row for each candidate measure and a column for each identified factor. Cells show loadings—the relative strength of each measure within each factor—ranging from 0 to 1. Ideally, loadings for a given candidate within a factor are above 0.7, and no candidate loads strongly in more than one factor. Cross-loading, indicating that a candidate measure is significant to more than one factor, usually means excluding that candidate measure from consideration to make sure each candidate measure works for one and only one latent variable. Through analysis, the patterns that emerge can either identify new, unanticipated factors or help tailor candidate indicators to pre-identified latent variables. Figure 4.6 shows a sample Pattern Matrix table for the factors identified in Figure 4.5. Factors 2 and 3 are clearly grouping

candidate indicators for the SID and PRH latent variables, respectively, but showing that AID and IID variables tested do not produce their own factors. Empty cells have loadings of less than .30, which are hidden due to the use of the BLANK(.30) FORMAT option. The last factor included, PRH-Reminds-success, loads somewhat weakly at .566, but is grouping as intended and not cross-loading (above .30) with other factors.

On sample size and its relationship to power, Malhotra & Grover (1998) suggest a sample of at least 100, and state "a general heuristic for multivariate analysis is at least five times the number of variables in the model" (p. 414). The number of variables and participants vary from stage to stage of the instrument creation process, and will be reported below.

Pattern Matrix

	Factor		
	1	2	3
AID-Who-I-am-now	.949		
AID-Expresses	.779		
AID-Part-of	.757		
IID-Ideal-self	.738		
AID-Someone-new	.725		
IID-Fits-who-I-want-to-be	.648		
IID-Closer-to-who-I-want-to-be	.587		
SID-Belong-to		.981	
SID-See-as-belonging-to		.814	
SID-Identify-with		.804	
PRH-Reminds--important-tech			.841
PRH-Reminds-tech-from-past			.708
PRH-Reminds-success			.566

Figure 4.6. Sample FACTOR Output for Pattern Matrix in SPSS

Like the RELIABILITY command, the FACTOR command can be used iteratively as candidate indicators that perform weakly or cross-load heavily are removed from consideration and the command re-run until a satisfactory set of factors and their indicators are identified.

The SmartPLS software package version 3.3.9 (Ringle et al., 2015) was used to perform PLS- SEM analysis on final survey results to produce multiple potential models for the phenomena

under investigation. Hair et al. (2022) provides the following rules of thumb for choosing PLS-SEM, which apply to this work:

- “The analysis is concerned with testing a theoretical framework from a prediction perspective;
- The structural model is complex and includes many constructs, indicators, and/or models model relationship;
- the research objective is to better understand increasing complexity by exploring theoretical extensions of establish theories (exploratory research for theory development);
- the path model includes one or more formative measures formatively measured constructs; […]
- a small population restricts the sample size (e.g., business-to-business research) [...];
- distribution issues are a concern, such as lack of normality” (p. 32).

After connecting SmartPLS to a data set, the software interface allows for the specification of a structural model and then testing of that model. The structural model has two components: an inner model and an outer model. The outer model is the way in which variables are specified as indicators for latent variables. The inner model specifies the way latent variables interact with each other. SmartPLS affords evaluation of both. In Figure 4.7, the outer model is the arrow-specified relationship between yellow boxes representing indicators and blue circles representing latent variables.

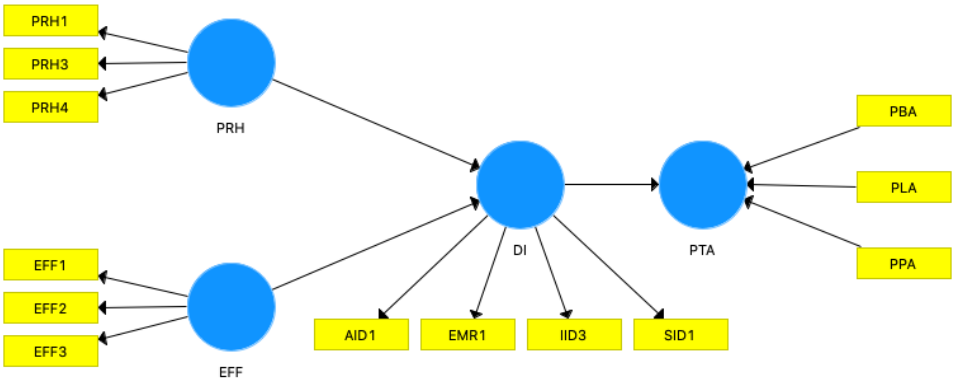

Figure 4.7. Sample Model Definition in SmartPLS

To evaluate the outer model, SmartPLS users can use its PLS Algorithm function. This function produces sets of reports to evaluate the outer model. As the FACTOR command above, SmartPLS tests reliability by producing Coefficient alpha scores (labeled Chronbach’s Alpha in

the application), as well as ρ_A (labeled rho_A), Composite Reliability, and Average Variance Extracted (AVE) scores. Chronbach's Alpha, rho_A, and Composite Reliability scores are considered acceptable above 0.70 and AVE is considered acceptable above 0.50. This work will utilize composite reliability reports for evaluation of reliability. Figure 4.8 is a sample screenshot of the SmartPLS Construct Reliability and Validity report. The red and green characters indicate unacceptable and acceptable results, respectively, with the AVE for EFF and PRH falling below the 0.50 threshold.

	Cronbach's Alpha	rho_A	Composite Reliabil	Average Variance I
DI	0.849	0.850	0.848	0.584
EFF	0.705	0.721	0.708	0.451
PRH	0.750	0.766	0.739	0.494
TAP		1.000		

Figure 4.8. Sample Construct Reliability and Validity Report in SmartPLS

The PLS Algorithm function also includes an Outer Loadings report which summarizes the coefficients of all relationships specified in the outer model. Outer loadings below 0.40 are considered unacceptable, those above 0.70 acceptable, and those between are conditionally acceptable based on how the indicators perform in terms of the construct's internal consistency and discriminant validity (Hair et al. 2022).

Discriminant validity—testing to make sure the latent variables are distinct from one another—is reported using the Fornell-Larker Criterion and the Heterotrait-Monotrait Ratio (HTMT). The Fornell-Larker Criterion "compares the square root of the AVE values with the latent variable correlations. Specifically the square root of each construct's AVE should be greater than its highest correlation with any other construct" (Hair et al. 2022 p. 121). HTMT "is the ratio of the between-trait correlations to the within-trait correlations" (Hair et al 2022 p. 121) which is considered acceptable below 0.90. The application's outer loadings chart can also be consulted: Items in reflective models with outer loadings under 0.40 be removed, items between 0.40 and 0.70 reconsidered in the context of other elements in the model, and items above 0.70 retained (Hair et al. 2022).

Graphical reports are also available, with statistics overlaid on the structure. Figure 4.9 is a sample model image after running the PLS Algorithm. Numbers connecting indicators to latent variables are their outer loadings. Numbers connecting latent variables to one another are path

coefficients. Numbers within latent variables are their R^2 values (labeled "R Square" in the SmartPLS interface). SmartPLS allows customization of the reported data for each of these elements.

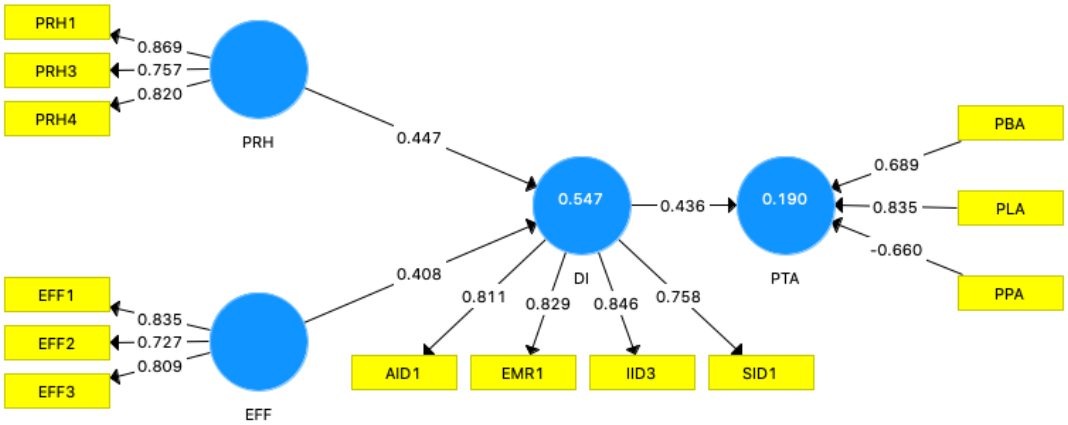

Figure 4.9. Sample Model with PLS Algorithm Results in SmartPLS

SmartPLS also allows for evaluation of the inner model through its Bootstrapping function. Bootstrapping uses subsamples (with replacement) of the linked data to evaluate the model. This function takes a variable for the number of subsamples produced, with 10,000 subsamples suggested for final analysis of a model (Hair et al. 2022). The reports which are produced include path coefficients, T Statistics, and p-values for each specified relationship. One- and two-tailed tests can both be performed, and significance level can be specified to help with color-coding of the resulting reports. In addition to report charts, SmartPLS updates the graphical model with customizable sets of statistics.

With SmartPLS, moderation effects can be performed with a number of different parameters. For this work, moderator analysis is performed using the Calculation Method: Orthogonalization, Product Term Generation: Standardized, and Weighing Mode: Automatic settings. Moderator models are evaluated with the same criteria as detailed above.

4.3 Qualitative Text Analysis

Qualitative text analysis methods were used on the open-ended short-answer questions near the end of the survey. The analysis of the survey's results used two forms of textual content analysis: deductive and inductive.

Deductive analysis involves interpretation of textual data in order to classify (‘code’) the text using a pre-existing dictionary of terms, which can then be analyzed using statistical methods (Lavrakas 2008). With these methods, “a researcher uses objective and systematic counting and recording procedures to produce a quantitative description of the symbolic content in a text” (p. 311). For example, given a pre-existing dictionary of topics within a discipline, a researcher could code a journal’s articles by their content to quantitatively analyze longitudinal changes in a publication’s content. Deductive analysis was used to code open-ended responses regarding iron triangle attitudes by criteria (budget, scope, schedule) and priority (constrain, enhance, accept). The open-ended question regarding product meaning was coded by identity function (effectiveness, emotional regulation, actual identity, ideal identity, personal history, and social identity) and IT identity dimension (emotional enhancement, relatedness, and dependence).
Inductive analysis involves generation of new codes based on analysis of the text. It is

> “the process of defining what the data are about[...]. Coding means naming segments of data with a label and simultaneously categorizes, summarizes, and accounts for each piece of data. Coding is the first step in moving beyond concrete statements in the data to making analytic interpretations.” (Charmaz, 2006 p. 43)

The open-ended questions regarding iron triangle attitudes and product meaning were all inductively analyzed for emerging themes relevant to those topics.

Another tool in inductive analysis is memo writing. During qualitative analysis, memo writing is a means of noting ideas emerging from the data. “Memos catch your thoughts, capture the comparisons and connections you make, and crystallize questions and directions for you to pursue” (Charmaz 2006 p. 72). Recording and reviewing these thoughts also facilitates higher order synthesis where memos overlap, and prevents their loss over the course of complex projects. Memo writing was also performed during qualitative evaluation of the open-ended questions regarding iron triangle attitudes and product meaning, and the memos used to produce the final write-ups of each.

Some responses that were rejected from quantitative analysis were included in qualitative analysis. Since the data flaw from the first round was restricted to project type, some responses were used where project type was not pertinent. Specific counts of valid qualitative responses are included in the matching sub-sections of Chapter 5: Findings.

4.4 Recruitment and Data Gathering

Separate forms of recruitment took place for the multiple phases of identity function measurement model creation and data gathering with the full survey instrument.

Card sort participants were recruited through personal requests and posts to a PhD student discussion board. No compensation was offered.

Participants for the tests of candidate indicators for the identity function measurement model were recruited through a service provided by Prolific. Recruitment took place in two rounds. Since Prolific's default screener data for their pool of potential participants did not include profession data, a profession screener was created using a set of qualifiers to approximate the profile of a software professional. These represent the target population for the research, while the sample frame was limited to members of the population active on Prolific:

- Employment Status: Full-Time or Part-Time;
- Work week: 21 or more hours;
- Some ability to program computers

Participants were sent to a short Qualtrics survey where they were asked "Are you currently working as a member of a software development team?" IDs of participants answering yes were subsequently invited to the pilot study of the new IT identity measurement model. Six hundred eighty-six (686) potential participants were identified.

For the software development screener, Prolific participants matching our profile were offered $0.25 USD for an estimated 1 minute of work ($15.00USD/hour). For the test of the measurement model, Prolific users who had passed the development screener were offered $1.25USD for an estimated 5 minutes of work ($15.00 USD/hour).

Qualtrics Research Services were engaged to recruit anonymous participants for the completed survey. Qualtrics staff were tasked with finding representatives of our target population: currently working software development professionals of any job title. Participants were also required to be at least 18 years of age and live in the United States of America or a country covered by the General Data Protection Regulation (GDPR). The sample frame, then, is individuals of this description who self-select to participate through the Qualtrics recruitment program. Participants recruited through Qualtrics were paid from the fees paid to Qualtrics, so specific compensation is unknown.

Recruitment occurred in three rounds. Round One consisted of 138 response cases. Unfortunately, a flaw in Qualtrics systems caused information on project type to be improperly stored. This was particularly problematic since project type is vital for some intended forms of analysis. Only 44 cases were able to be salvaged in terms of their project type data. Qualtrics acknowledged the error, corrected it, and re-opened the survey for additional data gathering. Round Two added an additional 79 cases, 14 of which were also rejected due to responses that were inconsistent with screening data. Round Three replaced those 14 rejected cases, bringing the total back to 125.

A copy of the survey was produced for public acquisition of data as well, specifically for the intent of acquiring more responses from developers of game software. The International Game Developer's Association was contacted and asked to post a call to participate for this second instance of the survey. The call was eventually posted on Twitter and was shared to LinkedIn and Facebook, producing an additional 22 response cases. These participants were not compensated.

4.5 Identification of Multivariate Outliers

Survey results were checked for outliers prior to SEM evaluation. Multivariate outliers were identified by computing a Mahalanobis distance for each case's reported set of values. Mahalanobis distance represents the distance between any single case and the distribution of all cases for a set of multivariate responses (Zach, 2020). This calculation is performed using the REGRESSION command in SPSS with the Mahalanobis Distance option selected. The p-value of each result can be calculated using a chi-square test with a number of degrees of freedom equal to the number of included variables. Convention suggests that any case with a resulting p-value of less than 0.001 be considered an outlier.

Mahalanobis distances were computed for the 147 fully valid survey responses. Five were identified as outliers and removed from further evaluation, leaving 142 responses which could be used for quantitative analysis. Guidelines from Malhotra & Grover (1998) indicate that 100 responses were required to show adequate power for analysis.

The next chapter looks at the application of these methods in this research project.

Chapter 5. FINDINGS

This chapter describes the application of methods described in Chapter 4. After describing the group who provided data, I will explain how results of SEM methods directed the creation of the identity function measurement model, the analysis of the identity function measurement model based on the final survey, and further analysis of the survey's open-ended responses for the sake of validating or reassessing quantitative choices, providing rich context for those results, and identifying areas of improvement in the models created.

5.1 Description of Survey Participants

This section describes the 142 responses used for factor analysis. Appendix A contains complete tables for each of the characteristics included here.

Gender was tracked, though there is no established theoretical basis for suggesting IT identities are strongly tied to gender identities. Respondents were 63.4% male 32.4% female, with 4.2% of respondents opting not to respond or responding in a non-binary manner. Employment type was tracked since it could provide insight into the nature of group identities that surface during analysis: 74.6% of respondents worked for the organization making the software while 21.1% were contract employees. Nearly half (45.1%) of respondents were between 31 and 40 years of age, and more than two thirds (68.3% were under 40). All but 21.8% of respondents had a college degree.

Software type, development method, project phase, and ownership were also tracked. Internal projects were most heavily represented (33.8%) followed by business-to-business (B2B; 27.5%), business-to-consumer (B2C) productivity (19%), B2C entertainment (12%), and B2C social media (4.2%). Of the five "Other" responses, two reported their product belonged to multiple categories. Most projects used agile methods (61.3%) rather than waterfall, while five of the "other" responses indicated forms of hybrid agile-waterfall practices. More than half (50.7%) of projects were in the executing phase, while 18.3% were in each defining and planning phases. A small number (4.9%) were in the closing phase. Nearly two thirds (65.3% of respondents were working on proprietary software projects while 32 were on FLOSS projects. The "other" responses for method, phase, and ownership provided no pertinent insights.

In addition to these traits, participants were also asked about the number of individuals on their team and in their organization, as well as their length of time with the team and organization.

These facets did not feature in analysis, but were asked to allow that possibility since these traits may affect group identities with the team and organization.

5.2 MEASUREMENT MODEL

A detailed step-by-step account of the exploratory process that produced the identity function measurement model for IT identity is available in Appendix B. This section summarizes the process and focuses on more critical aspects of analysis and comparison.

5.2.1 *Measurement Model Creation Overview*

The creation of the identity function measurement model was performed with a separate group of participants than that for the final evaluation of the model. SEM methods were combined with the intent of building a set of valid indicators for the set of latent variables represented by the identity-related functions of materials goods (Dittmar, 2011). The measurement model was created in the six-stage process summarized in Table 5.1.

Table 5.1. Triangle Attitude Responses

Stage	**Name**	**Participants**	**Method(s)**
1	Indicator Creation	---	---
2	Face Validity Test 1	PhD Students	Card Sort
3	Face Validity Test 2	PhD Students	Card Sort
4	Pilot 1	Prolific.com Recruits	Survey and EFA
5	Face Validity Test 3	PhD Students	Card Sort
6	Pilot 2	Prolific.com Recruits	Survey and EFA

Stage 1 was the creation of these original candidate indicators, based on existing literature when available. This initial set of candidate indicators was used in **Stage 2**, which involved testing each measure's face validity by asking doctoral student participants to perform a card sort of the proposed indicators into categories (colloquially "bucket") representing the identity-related functions of material goods. Participants were encouraged to speak aloud while sorting each candidate measure into an identity function bucket. This stage allowed an initial evaluation of the indicators without an outlay of funds. Candidate which repeatedly failed to sort as intended were

rejected or re-written based on feedback. It is worth noting that Symbolic Relatedness (SIR) was removed from consideration at this stage. **Stage 3** repeated the card sort process with a revised set of candidate indicators.

Stage 4 was a pilot using Prolific.com participants who were directed to a Qualtrics survey. Twenty-six (26) candidate indicators that passed Stage 3 were presented in matrix format with answers on a 5-point Likert scale from Strongly Agree to Strongly Disagree. Factor analysis techniques were used to evaluate the reliability and discriminate validity of the candidate indicators for their intended LVs. Stage 4 resulted in a strong theoretical re-alignment of the candidate indicators, described below.

Based on the results, the candidate indicators remaining at the end of Stage 4 were once again revised. **Stage 5** was another card sort and another revision to the language of candidate indicators. **Stage 6** was an additional pilot using the participants and methods from Stage 4.

5.2.2 *Stage 4 Analysis*

During Stage 4, four potential measures were tested for each remaining function.

- Effectiveness (EFF)
  - EFF1: I am confident that I make good decisions about the product.
  - EFF2: I have control over the product.
  - EFF3: The product lets me demonstrate competence in my profession.
  - EFF4: I influence the direction of the product.
- Emotional Regulation (EMR)
  - EMR1: I feel happy when I think of the product.
  - EMR2: I feel a sense of pride when I think of the product.
  - EMR3: My association with the product gives me a feeling of stability.
  - EMR4: My association with the product boosts my self-esteem.
- Actual Identity (AID)
  - AID1: The product is an important part of who I am right now.
  - AID2: My personal values are represented in the product.
  - AID3: I see part of myself in the product.
  - AID4: When I meet someone new, telling them about the product helps them understand who I am.

- Ideal Identity (IID)
  - IID1: I have a strong sense of how the product will help me achieve future career goals.
  - IID2: I am growing into a better version of me as I work on the product.
  - IID3: I want to make sure "future me" is happy with the completed product.
  - IID4: I feel the product will influence the future of the whole field.
- Personal History (PRH)
  - PRH1: The product is a natural extension of my professional work history.
  - PRH2: The product reminds me of technologies that were important to me in the past.
  - PRH3: I keep memorabilia regarding past products in my work space.
  - PRH4: A much younger me would be excited to know I was working on the product today.
- Social Identity (SID)
  - SID1: I am glad to belong to the product's target user group.
  - SID2: I feel strong ties with the product's target user group.
  - SID3: l consider the product's target user group important.
  - SID4: l identify with the product's target user group.

EFF was splitting into two groups. As Dittmar (2011) indicates, the "effectiveness function closely resembles the self-efficacy identity motive, where individuals strive to feel competent and capable of influencing their environment" (p. 549) and also that "the psychological significance of possessions is seen as residing mainly in the control they afford their owner over the physical and social environment, and they are closely linked to identity for precisely that reason" (p. 750). EFF1 and EFF3 are indicators for feeling competent when working on the product. EFF2 and EFF4 are about control, by influencing the outcome of the product. This suggests that there may be two separate identity functions in operation here, grouped together as effectiveness by Dittmar: competence (performing well) and control (influencing outcomes). The decision was made to introduce additional EFF candidate indicators pertaining to each for the next stage.

With ERM, ERM3 failed to factor with the others. Indicators for happiness, pride, and self-esteem correlated well, but the indicator for stability weakly associated with both ERM and a factor comprised mostly of AID indicators. ERM3 was removed and new ERM candidate indicators were

drafted, including two taken from consumer research. Dittmar (2008) notes that "emotional buying motives form a coherent, internally consistent dimension separate from other types of buying motives, reflecting concerns such as 'I get a real buzz from buying things' or 'I often buy things because it puts me in a better mood'" (p. 64).

With AID, AID3 failed to factor with the others and was removed. This difference also has a theoretical justification: AID3 asks if the participant sees themselves as part of the product, where theory suggests they should see the product as part of themselves. New candidate indicators were written to better reflect the direction of the relationship.

IID2 was not grouping with the others and was removed. IID3 used an emotional term ("feel") which is why it is believed that it loaded with EMR indicators. While Dittmar (2021) uses "feel" in her description if the ideal identity function, the meaning in IID3 was intended for the "intuitive" meaning of "feel" and not the emotional meaning. Theory suggests "people make use of material possessions, among other strategies, to compensate for perceived inadequacies in their self-concept" (Dittmar, 2007, p. 35 paraphrasing Wicklund & Gollwitzer, 1982), and that "people pursue material symbols in order to reduce discrepancies between their actual and ideal self, which raises the question of whether material goods are a beneficial strategy for dealing with identity deficits" (Dittmar, 2011, p. 31). New indicators were considered that dealt with perceptions of inadequacies, but were eventually rejected. It was considered potentially more effective to create indicators about self-improvement instead. For example, "the product helps me compensate for my inadequacies" seems to resonate poorly compared to "the product lets me improve myself" while conveying approximately the same sentiment.

PRH performed poorly overall and was considered for removal. Eventually it was re-written and retained. PRH1 seemed to directly reflect theory since it's about a symbolic record of personal history, but was simplified and focused on re-write. The wording of PRH2 was overly complicated. The original idea was to tie history to non-work tech, but that was theoretically misguided since the indicators should focus on the current product and not on other material goods. Similarly, PRH3 mentioned *other* projects (not *this* project). It also potentially confused material identification with the product and material identification with other materials (memorabilia). PRH4 was overly complicated, with the intent being to find if the current product induced feelings of nostalgia for past products, showing a personal historic link. PRH indicators were heavily edited, simplified, and re-focused on the current product.

SID indicators were originally based on Brown et al. (1986) which refers to Tajfel and Turner (1979) among others to suggest three categories of indicators for self-identification with a group: “awareness of group membership (which contributes to self-definition), evaluation (which relates to self-esteem) and affect” (p. 275). While Brown et al. includes reversed indicators, it was decided to avoid those during measurement model construction. Stage 4 used one of each, with a duplicate affect. While SID1, SID2, and SID4 created a factor, SID3—the lone “evaluation” item—loaded with other factors and was rejected. Other edits were made to remove possible EMR correlations (e.g., removing “glad” from an indicator).

The end of Stage 4 had a re-written, larger set of candidate indicators with better adherence to theory and less potentially emotion-based language outside of EMR.

5.2.3 *Stage 6 Analysis*

During the course of Stage 6, iterative use of RELIABILITY and FACTOR commands in SPSS narrowed the pool of candidate measures to 18. At this point, all RELIABILITY tests were producing results well in excess of the chosen 0.7 threshold for coefficient alpha (see Table 5.2).

Table 5.2. Coefficient Alpha of Identity Function Constructs

Identity Function	**Coefficient Alpha**
EFF	0.831
EMR	0.869
IID	0.891
IID	0.828
PRH	0.754
SID	0.901

The FACTOR command produced a Bartlet’s Test of Sphericity result with a significance of <.001, indicating that the data were suitable for factor analysis. Further use of the FACTOR command found that candidate indicators were adequately identified for factors corresponding to the EFF, PRH, and SID latent variables (see Table 5.3). While candidate indicators for EMR, AID, and IID were clumping together, FACTOR commands run while opting to produce the best three factors from that clump produced a set that sorted as intended (Table 5.4).

Table 5.3. Pattern Matrix for Stage 6

	Factor			
	1	**2**	**3**	**4**
IID4	0.869			
IID5	0.818			
EMR6	0.811			
EMR4	0.766			
EMR1	0.761			
AID3	0.661			
IID3	0.643			
AID1	0.641			
AID7	0.611			
SID1		0.976		
SID3		0.792		
SID4		0.774		
EFF2			0.887	
EFF1			0.804	
EFF3			0.677	
PRH1				0.862
PRH4				0.646
PRH3				0.572

Table 5.4. Pattern Matrix for the “Clump”

	Factor		
	1	**2**	**3**
AID4	0.906		
AID3	0.637		
AID1	0.620		
AID7	0.591		
EMR4		0.903	
EMR1		0.821	
EMR6		0.569	
IID3			0.815
IID5			0.606
IID4			0.415

At this point, the measurement model was considered strong enough to include within the full survey instrument. The included indicators were worded as follows:

- Effectiveness
    - EFF1: I have control over the product.
    - EFF2: I make important decisions about the product.
    - EFF3: I make good decisions about the product.
- Emotional Regulation
    - EMR1: I feel happy when I think of the product.
    - EMR4: Thinking about the product improves my mood.
    - EMR6: I find working on the product emotionally rewarding.
- Actual Identity
    - AID1: The product is an important part of who I am right now.
    - AID3: When I meet someone new, telling them about the product helps them understand who I am.
    - AID4: The product is part of me.
    - AID7: The product expresses something about who I am.
- Ideal Identity
    - IID3: The product fits who I want to be
    - IID4: The product brings me closer to the person I want to be.
    - IID5: The product brings me closer to my ideal self.
- Personal History
    - PRH1: The product reminds me of technologies that were important to me in the past.
    - PRH3: The product reminds me of my past successes.
    - PRH4: The product reminds me of tech from my past.
- Social Identity
    - SID1: I belong to the product's target user group.
    - SID3: I identify with the product's target user group.
    - SID4: I see myself as belonging to the product's target user group.

These indicators were integrated with the full survey, which is available in Appendix C.

5.3 PLS-SEM ANALYSIS

For this section, designation and evaluation of structural models was performed using SmartPLS (Ringle et al., 2015). Detailed notes on the exploratory process are available in Appendix B. When the SmartPLS PLS Algorithm function was run, the "Path" weighting scheme was used. When the Bootstrapping function was run, the following settings were used:

- Subsamples: 10000
- Amount of Results: Complete Bootstrapping
- Confidence Interval Method: Bias-Corrected and Accelerated (BCa) Bootstrap
- Test Type: One-Tailed
- Significance Level 0.05

The intent of this analysis is to determine the best model regarding the effects of an identity function model of IT identity and its power to explain attitudes towards the project outcome criteria of the iron triangle.

5.3.1 *First- or Second-Order Model*

In exploring the use of identity functions as indicators of a software development professional's self-identification with the technology under development, the first obvious issue regards the utility, composition, and structure of identity function indicators as a measure of self-identification. It was not theorized that the full set of identity functions would operate as a suitable construct for self-identification with technology. Rather, this section of the research has always been intended to identify those identity functions (if any) which are activated when self-identification is present.

Multiple models were tested, starting with a model (designated **Model 1**, not depicted) in which each of the identity function exogenous LVs (Effectiveness (EFF), Emotional Regulation (EMR), Actual Identity (AID), Ideal Identity (AID), Personal History (PRH), and Social Identity (SID)) reflected a second-order IT identity LV (DI). Checks for construct validity and reliability show that each identity function latent variable exceeded reliability thresholds for composite reliability and AVE with composite reliability scores ranging from 0.835 (EFF) to 0.923 (IID). However, the outer loadings shows that all EFF and PRH indicators load poorly into DI in this model. EMR6 (0.677) and SID1 (0.683) are also below the "good" threshold but well above the absolute minimum of 0.40. Further, analysis shows the model has discriminant validity flaws. The

identity function latent variables are not sufficiently distinct from one another to justify their use in a second-order construct for DI. All indicators seem to be covarying in a manner suggesting an underlying unidimensional construct.

The best alternative model to emerge (designated **Model 2**; see Figure 5.1) included EFF and PRH as formative LVs for DI, and the indicators from each other identity function (EMR, AID, IID, and SID) as reflective of DI. SmartPLS calculates that EFF and PRH account for 59.7% of the variance in DI under this model. All constructs exceed minimums for composite reliability and AVE, and HTMT scores show discriminant validity is achieved. With an acceptable model for IT identity using indicators based on identity functions, that model can be used as a foundation for modeling DVs.

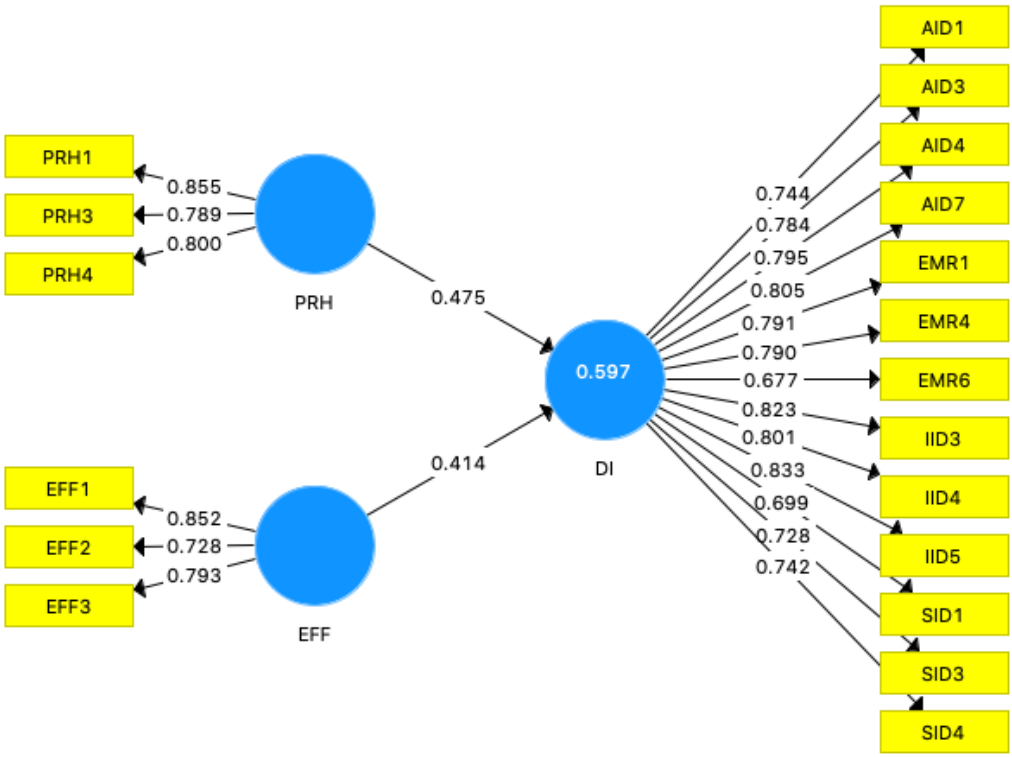

Figure 5.1. Model 2

Lacking an existing measure for risk behavior for software projects, the survey was designed to capture data regarding respondent attitudes towards the iron triangle criteria for their product. While the original prompt stated that lower numbers indicated greater importance, the response values were flipped so that the results show positive correlations as importance increases, which is a more intuitive way to interpret the results in the SmartPLS reports.

5.3.2 *Including DVs*

Model 3 (Figure 5.2) included an endogenous latent variable labeled PTA which is formed by the responses specific to attitudes regarding budget (PBA), scope (PPA), and schedule (PDA) for their product. PTA must be formative in construction since PBA, PPA, and PDA are not all expected to covary and are not seen as replaceable with other similar indicators.

In this configuration, PPA loads negatively against PBA and PLA. This issue is suspected to stem from fundamental differences between PPA and the other indicators. As will surface in qualitative analysis below, software projects often have a "time is money" mindset, and staff salaries are often the major expense in development projects. Schedule and budget are seen as expenses. It is expected that PBA and PLA will highly correlate, particularly for software professionals. Scope, on the other hand, is not spent like time and money. Where enhancing project performance in terms of budget and schedule involve decreasing money and time spent, enhancing project performance in terms of scope is a matter of increasing the quality of the deliverables. It can be expected that PPA is inversely correlated with PBA and PLA. Because PBA, PPA, and PLA do not function as formative indicators of an LV, this model was rejected.

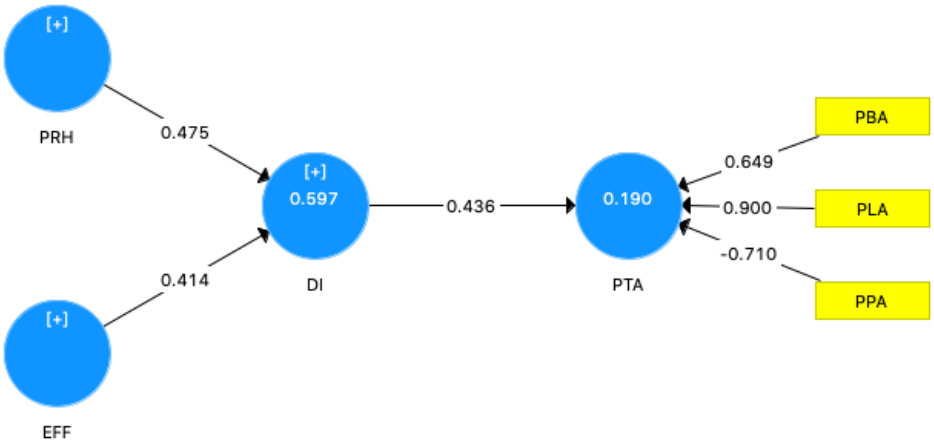

Figure 5.2. Model 3

Instead, PBA, PPA, and PLA were modeled as independent endogenous variables (designated **Model 4**; Figure 5.3). The R^2 for each relationship between DI and a triangle attitude measure can be characterized as weak, but still having informational value (Hair et al., 2022).

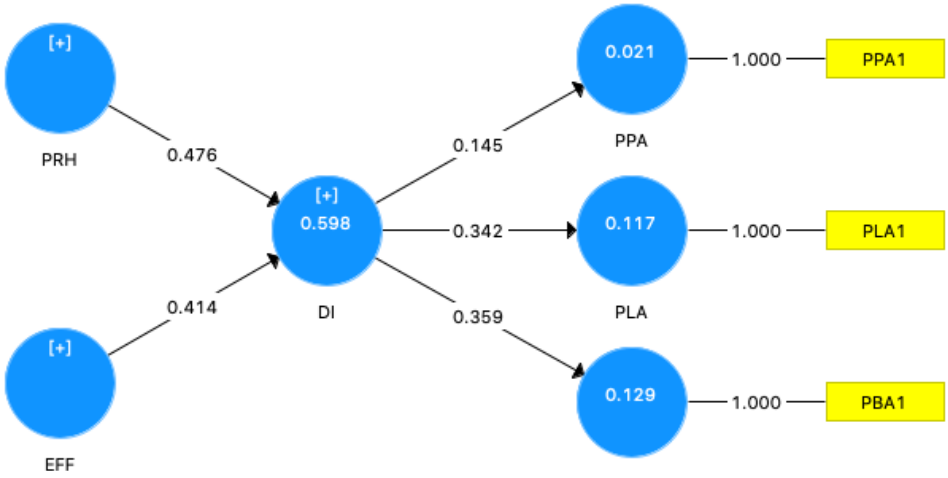

Figure 5.3. Model 4

5.3.3 *Testing Moderators*

Model 5 (Figure 5.4) builds on Model 4, integrating concepts regarding a general IT identity, labeled CGG. CGG is reflected in six indicators, two each regarding IT identity dimensions of emotional energy, relatedness, and dependence (DEPG1, DEPG2, RELG1, RELG2, EMENG1, EMENG2). CGG is theorized as moderating the effect of DI on each of the DVs. The CGG construct is introduced and connected to each DV, and the green circles represent moderating effects of CGG on DI for each DV (labeled MOD-X, where X is the appropriate DV for each).

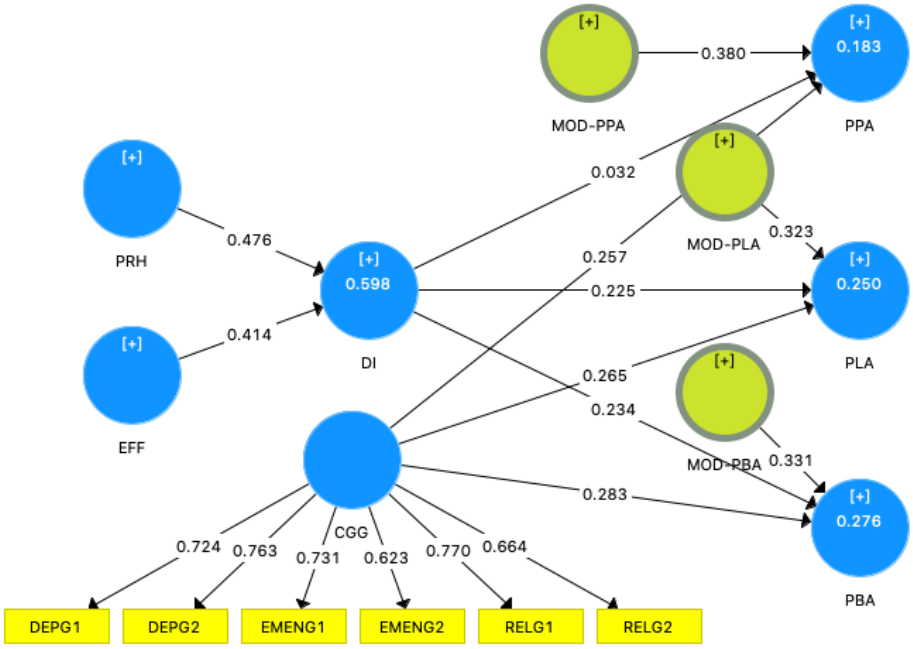

Figure 5.4. Model 5

The Outer Loadings report for CGG show loadings under 0.70 for EMENG2 (0.623) and RELG2 (0.664) but both the Construct Reliability and Validity report and the Discriminant Validity report show no problems with the construct. Since EMENG2 and RELG2 are both well above the 0.40 cutoff and part of a tested model for IT identity (Carter et al. 2020) they were retained. All other indicators tested above acceptability thresholds.

With the CGG construct passing checks, attention can turn to its interaction with the rest of the model. The PLS Algorithm reports indicate that all three moderating effects have insufficient AVE scores to remain in the model despite having adequate composite reliability scores (MOD-PBA: 0.254; MOD-PLA: 0.253; MOD-PPA 0.240). The moderators were rejected. The presence of CGG in the model does significantly increase R2 scores for all DVs.

As a check, **Model 6** (Figure 5.5) was created substituting a new CGP construct for DI. Like CGG, CGP is comprised of six indicators, two each regarding IT identity dimensions of emotional energy, relatedness, and dependence, but focused on the specific product under development rather than IT in general (DEPP1, DEPP2, RELP1, RELP2, EMENP1, EMENP2). The Outer Loadings report for CGP show one indicator loading slightly low (EMENP2: 0.694) but functions acceptably as a construct. Moderators were included once again, but testing the moderating effect of CGG on CGP for each DV. Again, low AVE scores called for the removal of moderators.

5.3.4 *Model Comparison: Explanatory Power*

Removing the moderating effects from both Model 5 and Model 6 created **Model 7** (Figure 5.5) and **Model 8** (not depicted) respectively. The PLS Algorithm was run on Model 04 (DI without CGG), Model 07 (DI with CGG), and Model 08 (CGP with CGG), and the results were compared (Table 5.5). Among these, Model 7 has the highest explanatory power for all three relationships between IT identity and iron triangle criteria attitudes.

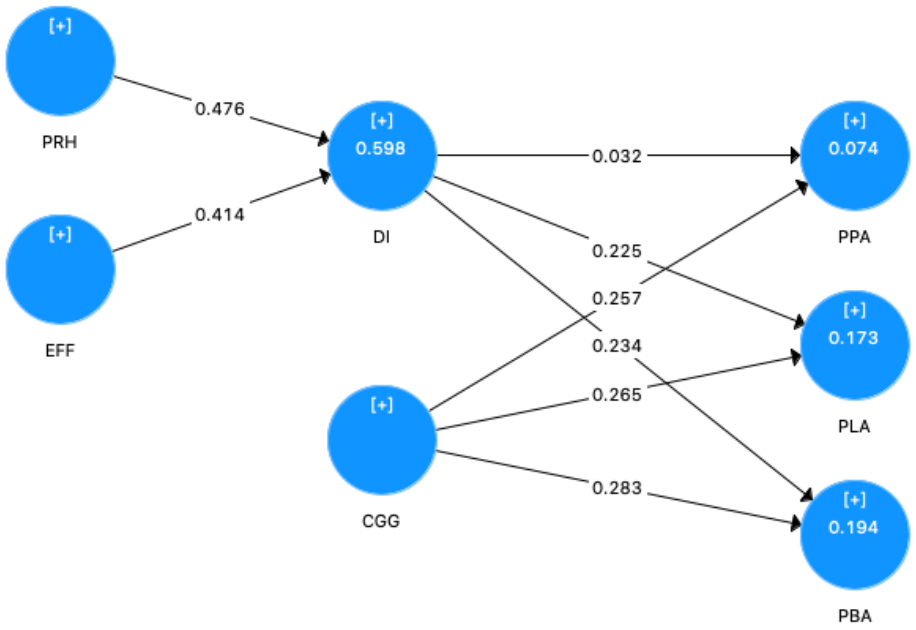

Figure 5.5. Model 7

Table 5.5. R^2 Comparison

	Model 4	**Model 7**	**Model 8**
PBA	0.129	0.194	0.173
PLA	0.117	0.173	0.146
PPA	0.021	0.074	0.073

5.3.5 *Bootstrapping the Final Model*

Bootstrapping was performed on Model 7 to determine the statistical significance of each relationship specified in the model. All connections are statistically significant (EFF->DI: 0.000; PRH->DI 0.000; DI->PBA: 0.001; DI->PLA 0.006; CGG->PBA: 0.000; CGG->PLA: 0.002; CGG->PPA: 0.003) with the exception of DI->PPA (0.378), which again shows the overall difficulty this project has experienced in modeling a relationship between IT identity and developer attitudes towards the scope of their project.

5.3.6 *Summary*

The exploratory SEM process used here has produced a model where indicators representing the effectiveness and personal history identity functions serve as antecedents for IT identity, and where IT identity can be measured using a set of indicators based on identity functions of material goods

paired with indicators for a general IT identity. For a software worker's self-identification with the product they are building, this model exceeds the explanatory power of current IT identity measurement models. This is theoretically significant, as it presents a new set of indicators for IT identity, suggests a difference between IT identities for creators and for users, and suggests a path of exploration for new general IT identity indicators based on identity functions.

Dependent variables—attitudes towards the schedule, scope, and budget of the participant's current project—were best modeled individually rather than as a formative construct. The model has weak but still informational explanatory power regarding attitudes towards budget and schedule, but fails to explain attitudes towards scope. While traditional use of the iron triangle presents them as complementary success criteria, this work suggests that scope is distinct from the other two criteria, at least in the way that worker attitudes are formed and affected by self-identification with the product.

Attempts to model moderators based on the proposed theoretical model all failed to pass one or more validity checks, including those directly represented in the theoretical model presented here (Figure 3.5). Under Product Characteristics, the sample size prevented testing of Goods Type, Feature Set was considered too complex to model, and Intended User was better modeled as a Social Identity with the user group. Situational Influences were unexplored in this portion.

5.4 Iron Triangle Analysis

In addition to the quantitative questions about prioritization of the elements of the triple constraint (budget, scope, and schedule), open-ended questions were asked to elicit further information on priorities. This portion of the survey was intended to function in the manner of a critical incident interview question, focusing on a critical event and the participant's reaction to it (Klein et al., 1989). The question series is as follows:

> Please think of a time when the team had to make a decision that would impact the product's schedule, budget, or scope when answering the following questions.
>
> - Briefly describe the situation and decision.
> - How did you personally decide which option was best (regardless of which path the team chose)?
> - What were the pros (the factors in favor) you weighed in your decision?
> - What were the cons (the factors against) you weighed in your decision?

The Qualtrics-recruited version of the series combined the pro and con questions into a single question, but this format complicated analysis. The question was divided into two for the public version of the survey. Any future work with the instrument should continue to separate pro and con responses. Of the total cases, 147 contained analytically useful responses. Illustrative responses are included in the analysis below. Extracted quotes are presented verbatim, including typographical errors.

These responses were primarily analyzed in two ways: deductively for the manner in which participants address the project criteria of the iron triangle (budget, scope, and schedule) and inductively for concepts that may inform the creation of new indicators for future quantitative analysis of attitudes towards the iron triangle criteria.

Responses were classified to capture the priorities or attitudes they held regarding the iron triangle criteria in the situation described. For each criterion that emerged, the response was coded by whether the participant indicated a preference for enhancing the criterion (+1), constraining the criterion (0), or accepting the criterion (-1). For example, a participant whose story involved slipping the project schedule in order to complete the product as specified would be classified as "accept schedule, constrain spec, and did not mention budget" with no criterion attached to the "enhance" priority. If a participant had exceeded their original budget in order to work in new features, the classification would have been, "accept budget, enhance spec, did not mention schedule" with no criterion attached to the "constrain" priority.

This concept of criteria priority is not necessarily ordinal in nature. While constrain and accept are easily interpreted as high and low priority, respectively, the enhance priority is not necessarily higher than the constrain priority. Practically, the simple prioritization scheme is a tool for decision making during planning and execution of a project. Analysis here does not intend to identify the project's overall priorities. Regardless of its original priority classification, any criterion can be positively or negatively impacted by circumstance and decisions during the course of a project. For example, an enhance priority criterion can negatively change during a project if the perceived choices are between it and the constrain priority criterion, if no change option for the accept priority criterion seems possible, or if the magnitude of impact to the accept priority criterion seems too great. Analysis, therefore, is based on how each criterion is treated situationally in the participant responses, not how each criterion was classified by project management or how it was prioritized in other decisions throughout the project.

5.4.1 *Quantitative Reporting of Iron Triangle Criteria Priorities*

Before qualitatively examining open-ended responses by criterion, quantitative descriptions of responses can provide some insight as well. Table 5.6 shows a summary of raw responses. The information in this table has not been flipped (as was done in the PLS analysis for the sake of more intuitively interpretable coefficients). For every criterion, 1 (highest) was the most-selected option. As can be seen in the cumulative percentage column, nearly half of all responses fall into the top third of response options (1-3) across all three criteria for both product and general consideration, with small margins of preference afforded to product over general. The product spec receives the most "1" responses for both the current product and IT projects in general, though cumulative percentages for the top third show attitudes towards the schedule taking priority over spec.

Table 5.6. Triangle Attitude Responses

Response	**PBA**			**PPA**			**PLA**		
	f	**%**	**c%**	**f**	**%**	**c%**	**f**	**%**	**c%**
(Higher) 1	46	19.4	19.4	69	29.1	29.1	60	25.3	25.3
2	40	16.9	36.3	23	9.7	38.8	35	14.8	40.1
3	29	12.2	48.5	26	11.0	49.8	34	14.3	54.4
4	26	11.0	59.5	28	11.8	61.6	22	9.3	63.7
5	10	4.2	63.7	8	3.4	65.0	12	5.1	68.8
6	19	8.0	71.7	22	9.3	74.3	16	6.8	75.5
7	34	14.3	86.1	37	15.6	89.9	27	11.4	86.9
8	27	11.4	97.5	19	8.0	97.9	23	9.7	96.6
(Lower) 9	6	2.5	100.0	5	2.1	100.0	8	3.4	100.0
	GBA			**GPA**			**GLA**		
	f	**%**	**c%**	**f**	**%**	**c%**	**f**	**%**	**c%**
(Higher) 1	44	18.6	18.6	54	22.8	22.8	52	21.9	21.9
2	33	13.9	32.5	31	13.1	35.9	30	12.7	34.6
3	37	15.6	48.1	29	12.2	48.1	36	15.2	49.8
4	12	5.1	53.2	37	15.6	63.7	20	8.4	58.2
5	15	6.3	59.5	10	4.2	67.9	13	5.5	63.7
6	23	9.7	69.2	21	8.9	76.8	21	8.9	72.6
7	40	16.9	86.1	27	11.4	88.2	26	11.0	83.5
8	27	11.4	97.5	18	7.6	95.8	31	13.1	96.6
(Lower) 9	6	2.5	100.0	10	4.2	100.0	8	3.4	100.0

In addition to raw scores, net scores were produced to see if individuals rated the general criterion or the product criterion as more important. Simply, the difference between each product criterion attitude and its matching general criterion attitude was calculated (PBA - BGA, for example). Table A.4 (in Appendix A) summarizes the results from the perspective of the product criterion in each pairing, both by direction of preference and magnitude of preference. The table breaks this information down by product type. Bold text shows the greater of the values in each pairing. “Other” product types are provided for overall numbers, but are not intended to be significant as a grouping. From this report, we see that most participants rated their attitudes towards their current product and IT projects in general at the same level. This is not an artifact of submitting default values from the instrument, which defaulted to 5 but required the instrument to at least be manipulated before submitting the page. Distributions show 5 was an infrequent choice across all items. Instead, we see the dominant position is that the participant is prioritizing their current project’s success criteria as they do with IT projects in general.

Looking at those participants who did vary their attitudes between their product and software products generally, participants in each software type consistently tend to consider their product’s schedule more important than schedules in general. Those working on internal products more frequently devalued their own scope while prioritizing their own budget and schedule. The few B2C Productivity participants who did not equally rate their attitudes strongly preferred their own schedule. B2C Entertainment respondents had a similar set of attitudes towards budget.

Looking at those participants who did vary their attitudes between their product and software products generally, participants in each software type consistently tend to consider their product’s schedule more important than schedules in general. Those working on internal products more frequently devalued their own scope while prioritizing their own budget and schedule. The few B2C Productivity participants who did not equally rate their attitudes strongly preferred their own schedule. B2C Entertainment respondents had a similar set of attitudes towards budget.

Among all respondents, there is a trend to see their own product’s iron triangle criteria as more important than those of software projects in general.

5.4.2 *Qualitative Findings in Iron Triangle Open-Ended Responses*

Inductive and deductive qualitative text analysis methods were used to analyze the responses to the open-ended question focusing on iron triangle attitudes. This section begins with findings that

impacted the quantity and type of responses before moving to the iron triangle criteria themselves and then additional observations.

5.4.2.1 Self-Exclusion

In addition to participants who opted out of answering with no explanation, one subset explained their exclusion in terms of on-the-job powerlessness. While the question is specifically worded to elicit opinions regardless of actual decision-making power, 7 participants declined to answer based on feelings of powerlessness regarding product decisions.

- "I'm sorry, but I am too low in the organization's hierarchy to have any meaningful insight."
- "My lead talks to producers and then tells my department the upcoming schedule. I have no part in these meetings that decide the schedule."
- "Decisions about schedule, budget, and scope are way way way above me. I just accept whatever is told to me."

While identity functions did not appear frequently in the open-ended responses, this is certainly a negative expression of the effectiveness function, which involves perceptions of control.

5.4.2.2 Non-Project Answers

Several participants strayed from the strict definition of project used in this work. Among the responses, 18 were identified as involving BRM and 11 as involving portfolio management, two of which discussed both. Of these, 17 also included some form of project context as well and all but 5 used language expected when discussing the iron triangle. While language involving project management, portfolio management, and BRM can be similar, the timing of the issue addressed fell outside that of a project as defined for this research. Responses identified as pertaining to BRM and portfolio management were retained for analysis.

- BRM
  - "Making more money down the line for the company is a pro."
  - "Pro was all the time it would save over the year. The con was the impact it had for orders to be shut down"
- Portfolio management

- "Recently we were tasked to refresh all of our websites. I suggested we just add a fresh coat of paint to save time and money. It would allow us to focus on other projects that are deemed higher priority."
- "We had to make a decision on what older versions of our software we would continue to support. We decided to support back to versions released X number of years ago."

- Both
  - "I keep a focus on our bottom line while at the same time make sure that I focus on us not losing our edge with innovation. The pros and cons start and end with return on investment."

While this work focuses on project management, these other related disciplines are certainly valid extensions for future work.

5.4.2.3 Co-occurrence of Criteria and Priorities

Results of the qualitative evaluation of the open-ended questions on iron triangle attitudes are summarized in Table 5.7, a co-occurrence grid. Each criterion was given a single value, so there is no co-occurrence data between priorities for a given criteria. Within each criterion, the accept, constrain, and enhance priorities are represented by their initial letter. Numbers on the diagonals represent the total number of responses classified in each criterion/priority combination.

Table 5.7. Triangle Criteria Co-occurrence

		Budget			Schedule			Scope		
		Acc	Con	Enh	Acc	Con	Enh	Acc	Con	Enh
Budget	Acc	24								
	Con		12							
	Enh			7						
Schedule	Acc	8	1	3	34					
	Con	8	4	0		34				
	Enh	1	1	0			8			
Scope	Acc	0	5	0	2	8	2	16		
	Con	11	5	2	17	11	5		43	
	Enh	4	0	1	3	0	0			8

Acc = Accept; Con = Constrain; Enh = Enhance

The constrain-scope pairing appeared most often (43 times) and most frequently with accept-schedule (17) and accept-budget (11). This indicates that participants most frequently opted to share information about how budget and schedule measures were sacrificed to preserve a target

scope. While the SEM analysis shows no relationship between self-identification and scope attitudes, participants opted to share tales that prioritized scope. Scope is important to these individuals even though there is no statistically significant relationship to an IT identity with the product.

Enhance responses were infrequent compared with accept and constrain responses, as most participants wrote of preserving a criterion at the expense of another rather than of improving a criterion at the expense of another.

Interaction between iron triangle criteria is more diagnostic than simple mention of a criterion. These co-occurrences—especially those where one criterion is constrained or enhanced while another is accepted—allows insight into priorities and risk behavior, as seen below.

5.4.2.4 Scope

Responses included accepting a diminished scope less frequently (16 occurrences) than accepting diminishment of either other criterion (schedule: 34; budget: 24). Concessions on scope were most frequently made in favor of schedule.

- “During Covid we were pressed for time and money and were late getting a product out. Wasn’t a perfect game because it was rushed.”
- “We were approaching a deadline and needed to finish the product quickly. Some quality control measures had to be overlooked or shortened.”
- “We had to review curtailing some automation features for the sake of timeliness. I reviewed feedback from my team, then determined the aforementioned features could be added in a later patch. We have a hard deadline that gave me no other choice.”

These comments also illustrate how many respondents consider scope as more than a list of features. Participants regularly comment on the quality of the code and infrastructure in ways that end-users may not recognize but definitely impact the quality of the product from the organization’s perspective. This has implications for writing new indicators for a composite scope attitude.

- “Subjectively, also manages to reduce a lot of wasteful operations, which 'feels' more 'elegant'”
- “We decided on public cloud because it was more bold”

- "Removed a short-term hack that no longer had a clear expiration date [and] Removed our dependency on a vendor who has been less reliable than anticipated"

MVP releases and agile development practices also make it more difficult to evaluate scope attitudes. Several examples show sacrifices to short-term definitions of scope with justification that the functionality will soon be added through a future release. Such occurrences were classified as accept-scope because of the immediate loss of functionality, but software developers may not see it as such. If individuals are self-identifying with the product as represented in its scope and not its current state, rolling releases create an environment where the long-term vision for the product remains relatively constant and workers' self-identification with the product is not challenged by intermediate releases.

- "I decided to just release a beta version to a select group of people then receive feedback about bugs and issues with the software the. Release the full product after we had an idea of how our product was guna look when we released the final product."
- "Schedule was chosen over scope in this case because the feature wasn't essential and had value being delayed to a later release. If that wasn't the case, we would have slipped the schedule."

At other times, short-term shortcomings were acknowledged as requiring future fixes to the product, a phenomenon referred to as technical debt: "making technical compromises that are expedient in the short term, but that create a technical context that increases complexity and cost in the long term" (Avgeriou et al. 2016, p. 111). Repeating a comment from above:

- "We had to review curtailing some automation features for the sake of timeliness. I reviewed feedback from my team, then determined the aforementioned features could be added in a later patch. We have a hard deadline that gave me no other choice."

This is one of eight comments tied to accepting scope which implied a need to overcome technical debt. Another:

- "The latest project I was working on had an initial scope that included features for both authenticated users and guests. The schedule tightened, so removed the guest features and moved them to another project. Delaying delivery for the guest features allowed QA team to test the bulk of the product while I work on the new guest features. Unfortunately, that meant that guests will have to wait for their features"

In these cases, it is uncertain whether the participant believed they were accepting a loss of scope or if the cyclical nature of development allowed them to frame it as constraining scope and, perhaps, sacrificing schedule. The relationship between an individual's willingness to take on technical debt and their self-identification with the product may be a productive area of future study.

While attitudes towards scope were not found to be related to strength of IT identity in the SEM analysis, scope was the criterion most often discussed in the open-ended responses, most often constrained or enhanced in open-ended responses, and most ranked with 1 (most important) through the attitude measurement instrument. It is also, theoretically, the artifact most directly representative of the product under development, which makes the lack of statistically significant correlation between spec and self-identification with the product unexpected. There are several possible causes. The nature of agile development, with changing features and regular releases, seems to complicate individual perceptions of what the spec contains and how attention to the spec is prioritized. Also, the quality of the underlying code may be of importance to self-identification in tech workers rather than just specified functionality. Finally, high prioritization of the spec may be part of the standard for another shared identity in the sample, such as the role identity of software developer.

5.4.2.5 Schedule

Half of respondent decisions that involved accepting an expanded schedule were most frequently as a trade-off with constraining scope.

- "I chose the longer and more timely expensive route to be sure it's done the right way rather that taking short cuts and jeopardizing the outcome"
- "Pro: Text-averse artists would find a graphical layer 'sexier' and less threatening than something that looks like computer cose. Con: It would take me many months to write and debug"

Eight (8) responses included acceptance of both schedule and budget, 7 times with mention of constraining or enhancing scope. This was the largest area of co-occurrence with two accept priorities. The link between time and money in software development will be explored further below, in discussion of budget.

Seventeen (17) comments involved adding workload to staff, usually for the benefit of schedule while seldom declaring what other criteria of the iron triangle this impacted. Overtime, either willing or mandatory, may or may not impact budgets depending on the employee's status, morale issues that lead to resignations can affect schedules, and work done when tired or under the stress of deadlines tends to include more flaws (Take This, Inc. 2021). These potential impacts to the success indicators that comprise the iron triangle are where staff workload decisions can affect projects. Participant responses tend to focus on the short-term benefits of overtime and not the associated drawbacks.

- "Developing a new program during the pandemic and we only had 3 team members, we had to have it done in a week. We worked day and night and finished it for presentation in 4 days."
- "We lost a couple members of our team and have had to work long hours to pick up the slack. I decided that we had to work crazy hours to make this project happen. The pro was that we can stay on schedule and the con is we are exhausted"
- "I decided too have everyone work more hours so we could make the deadline."

Some, however, acknowledged tradeoffs.

- "I decided what was best with for my teammates, even though it would take a little longer than we wanted, it's more important to have sharp employees."
- "I told them how we needed more people and that it was more than a need it wasn't getting done other wise. It would cost the company more money was the con the pro was it prevented burn out and we are on track to finish on time"

Willingness to participate in overtime work may be part of several identity standards tied to software development. Participation in overtime may serve as an indicator for the effectiveness, social identity, or ideal identity functions for those who self-identify with the product under development. As effectiveness, overtime may offer a sense of control and contribution during a vital stage of development. As a social identity function, it may show a willingness to make the same personal sacrifice as other members of an in-group, embracing the hard-working self-sacrificing culture of a team or an organization. As an ideal identity function, personal sacrifice may be seen as a means to impress management for promotion, or to make up for self-perceived shortcomings in other areas. A willingness to partake in overtime was considered as an indicator for this study, but was rejected as insufficiently discriminant of any single identity function LV.

PLS shows EFF is an antecedent of DI and that SID and IID served as indicators of DI, causing problems for inclusion in future versions of the model.

One participant's response seems to involve pulling staff from other teams instead of mandating overtime.

- "The most important thing was getting the product back up, so that meant all hands on deck."

This participant is part of a small team (1-4 people) in a large organization (500-999 people). While it is possible that "all hands" is limited to their team, it is more likely that workers were temporarily moved from other projects. Another participant makes team-switching clear, because of staff turn-over.

- "We experienced substantial turnover internally which resulted in the team needing to shift directions. We had to recruit other staff from other projects to fill those vacancies to ensure that our project stayed on track."

These responses point to potential indicators of self-identification with the product: Perceived importance of the product within the organization and willingness to switch between product teams. Both conceptual models of IT identity included in this report involve resistance behaviors. While the original description of IT identity conceptualizes this as "resistance to new, replacement IT" (Carter and Grover 2015, p. 946), and while resistance behavior in Figure 3.5 was originally conceptualized as a resistance to scope change, the phenomenon may instead be enacted by a resistance to change between product teams. This would be easier to detect in highly agile, large project-based organizations, but would conceivably affect job satisfaction if, as risk literature suggests, workers are considered interchangeable collections of job skills rather than individuals who self-identify with the IT under development.

5.4.2.6 Budget

Budget had the fewest overall appearances (43) in the data set. The view of budgetary issues also seems most consistent and simplistic: There are few remarkable concepts emerging from this area. The accept-budget classification is most applied when also constraining or enhancing scope.

The most common co-occurance of "accept" priorities were with budget and schedule (favoring scope). This may be related to the "time is money" connection where individuals appropriately note that software labor is often linked to both: The longer the work takes, the more

money must be allocated to pay for labor, benefits, cloud services, rentals, and more. This is reflected in several comments, across priorities.

- “When we had a minor set back on rendering a battle scene we had to retrace our methods and go backwards and that interfered with time management and time is money.”
- “It was about how much we had left to spend on time conspumption and I had to come up with a budget on how long we could use a certain room.”
- “The allocated budget was somewhat low so the team worked extra hard to makes the project deliver is less time and was still effective, thus saving dollars.”

In this last example, extra labor is brought up again, this time explicitly using extra labor to compensate for budget shortfalls, indicating that the additional “hard work” was likely uncompensated, or expected from salaried staff.

As mentioned, scope is the most common beneficiary of accepted budgets. In 15 comments, accept-budget was paired with constrain-scope or enhance-scope.

- “We had to change the programs base over to a Linux system which would put us above budget but we made the change anyway and it works for the better.”
- “The pros what happened to be the final product turning out much better than if we rushed. The cons obviously being that it's going to take more time and possibly more money.”

The inverse did appear, with constrained budgets causing a loss of functionality. However, accept-scope was paired with constrain-budget only 5 times, and never paired with enhance-budget. This is one third of the occurrences of the reverse pairing.

- “We had a very small budget for a product and we had to take away some features that would have been originally in it. We just didn’t have the budget for our idea. We had to be more creative with our product with a small budget and cons were we didn’t get to implement our ideas”

5.4.2.7 Social Identity Function

In addition to providing insights on possible indicators for DVs related to iron triangle attitudes, the response set being analyzed here provides insight into possible social identity function indicators.

To better inform creation of indicators for the social identity function, responses were also classified if there was indication that a specific group was impacted by the decision. The groups that emerged from analysis (and the number of instances) were: intended users (28), the project team (34), the organization (18, including references to management), investors (3), and the board of directors (1). It is worth noting that these groups are not mutually exclusive: Intended users can be project team members who are a part of the organization. Responses were coded by specific mention, not potential inference, so comments regarding benefits to the project team were not automatically coded as regarding the organization.

- "I considered the pros and cons of the options, and also how each option would influence our long-term plans for our team and organization. [Pro:...] Significantly simplified our user experience"
- "Trying to decide how many people would benefit from having it versus the cost to use it. It has so much to offer that it could change the way in which my job is done. The cost was high but so is the quality of the product and the results it can produce"
- "We had to decide whether to include additional legal disclosures that would have been safer from a regulatory perspective, but would have significantly worsened the end user experience[....] The pros were that it would be an easier and smoother experience for the end users, but the cons were that the risk profile did increase slightly."
- "We were getting close to finishing the prototype software and we ran out of our budget and had to find funding elsewhere. I had to choose to either shut the project down or put my nose to the grindstone and find some investors."
- "I often have to make very important decisions regarding the timelines and structure of our application development. I am well equipped to make these decisions for our board of directors."

While the SEM portion of this research focused on activation of the social identity function with the intended users, self-identification with the project team and the overall organization present additional potential indicators for the social identity function. Self-identification with the board of directors and investors both seem to be less likely functions, but research regarding self-identification as a shareholder may be productive in organizations with benefits such as stock options, or for small employee-owned organizations. While social identities are obviously in play, IT identity is theorized as a form of material identity, so it is extremely important for this work to

make sure that the indicator is for a social identity function of the product under development. If the group connection being investigated isn't highly reliant on the specific product—if it could be easily activated regardless of the specific product—it will be less useful for IT identity studies.

Additionally, specific social identity functions and iron triangle criteria should correlate in that decisions regarding scope would logically seem to correlate with self-identification with the user group while concerns for budget and spec would correlate with self-identification with the host organization. In short, users can more easily be seen to benefit from better features while the organization benefits from better performance in regards to schedule and budget.

5.4.3 *Summary*

Since specific risk-related behaviors were too numerous and project-specific to use as indicators for the measurement model, the model instead use attitudes towards success criteria, theorizing that a lack of concern for a success criteria would indicate a willingness to sacrifice it.

Participants were asked to evaluate their prioritization of the iron triangle criteria for both their own product and IT projects in general. Though participants often rated a given criteria the same between their own project and general IT projects, a majority of those splitting their votes favored their own schedule in every type of software considered. However, ratings for all three criteria trended high for both. While the 9-point rating scale for prioritization was intentionally chosen over a simpler ranking instrument, the results may have been aided by a less nuanced means of priority comparison. In addition, participants often cited BRM and portfolio concerns in open-ended questions, indicating another area in which the survey instrument may be improved in order to generate more informative results.

The SEM work showed that attitudes towards project scope were not statistically significant in relationship to IT identity in the measurement model, but they did have considerable importance in other regards. In open-ended responses, scope was accepted least and constrained or enhanced more than schedule or budget, indicating that participants highly valued meeting or exceeding their products' specifications. Analysis suggests that the nature of agile development (with iterative releases, confusing an overall "scope") and the quality and elegance of the code (rather than just the observable quality of features), may be complicating attitudes towards spec. These observations provide direction for future work regarding a worker's attitudes towards the

scope of their product, and insights into the possible reasons that scope was not significantly associated with self-identification with their product.

Several participants tie schedule and budget together through their responses. Themes emerging from responses coded for schedule and budget include expectations of additional staff labor (to overcome issues with schedule with no impact to budget) and willingness to switch between teams (or quit). These specific behaviors that can impact schedule and budget may, in the future, serve as more indicative DVs than an overall attitudes towards schedule and budget, as they represent some of the specific behaviors that are expected in the theoretical model which seem to have broad applicability in the domain.

Finally, responses to the open-ended questions about iron triangle attitudes also provided some insight into the social identity function, as participants routinely mentioned the stakeholders affected by decisions for better or worse. These responses suggest new approaches to indicators for the social identity function of a worker's self-identification with their product, rather than a singular focus on the end user as was used in the SEM.

5.5 Product Meaning Analysis

Responses of the open-ended question regarding the participant's relationship to the product were iteratively analyzed for their relationship to the identity-related functions of material goods and to the existing dimensions of IT identity. Each function and dimension was analyzed separately. Responses were classified by whether comments included positive references (+1), negative references (-1), uncertain or neutral mentions (?) or no mention (0). Memoing was performed to illuminate emerging themes, clarify and improve the consistency of analysis, and ease reporting.
After participants completed the matrices of Likert response questions meant to establish a measurement model for IT identity in technology team members, they were then asked a follow-up open-ended question:

> Now that we have asked you to consider your relationship to the product, we'd like you to tell us more about that relationship.
>
> What does the product mean to you, personally?

The question does not ask, "What are you in relation to the product" which would be expected to produce a great number of role-based answers focusing on the participant. Rather, the question asks more broadly about the relationship between participant and product, placing emphasis on the

product. For this reason, it is more revealing when participants respond to the stated question with descriptions of themselves rather than the product. It is specifically written to encourage participants to answer in terms of the preceding questions regarding their relationship with the product. In this section, I report on the qualitative analysis of the body of responses, organized by the latent variables in the existing and proposed IT identity models.

By focusing on the product, this framing of the question also seems to have prevented any conflation of the software development tools with the product. In software, there is a distinction to be made between the tools used to create software and the resulting software (which may also be a tool). This research focuses on self-identification with the software product under development and not with the software tools used to make the software product.

In this section, I analyze participant statements as they illustrate the identity-related functions of material goods and dimensions of IT identity. I examine the ways in which the statements reflect the specifics of both established and proposed indicators of IT identity, similarities and differences between the language used in the definitions and descriptions of indicators and dimensions and the specific language used by participants, the appearance of anti- and dis-identification in the responses, and the implications of these results on future research into IT identity measurement models. Extracted quotes are presented verbatim, including typographical errors.

5.5.1 *Effectiveness*

During the creation of indicators for effectiveness, quantitative analysis and testing produced a set of indicators focused on control over the development of the product, and while control statements did appear in the participant responses, they also included a diverse set of statements regarding autonomy, competence, and impact on others.

Statements of control involved control over the development of the product and control afforded by the product. In the same general manner that solving a Rubik's Cube is a means of exhibiting control and mastery over the puzzle and puzzle-solving skills, the solving of work problems related to the product is a way the product can serve an effectiveness function.

- "I'm proud of the technical challenges I personally solved."
- "It's a product that depicts my intellectual ability."
- "[... It] allows me to maintain a skill set I possess"

- “This product has become a direct reflection of my IT skills as a developer, analyst and chief director showing off my skills, training, expertise and problem solving skills.”
- “It means a bigger check and a sense of feeling superior.”

This function extends to the course of their careers:

- “To me personally the product is a way of showing my worth to the business”
- “It's the biggest project I have worked on at the company and the first one I'm in charge of. It had lasting effect on my future Here and in my career”
- “It means that I’ve come a [long] way in my career to being able to develop these programs”

Other statements of control seem to expressly conflate employment with the product. Several participants mentioned that work on the product afforded them control in their non-work lives:

- “Producing product means that I am employed and have the income to meet my family's needs.”
- “It pays for my giant house, expensive hobbies, and children's educations.”
- “A reliable paycheck that allows me to live in one of the most expensive cities in the United States.”

Effectiveness was also expressed as impact on the participant’s environment, others, or even the whole world. Through work on the product, participants claim to afford a positive change in others’ experiences. Such claims to power are expressions of mastery, though not over the software itself. Rather, it is a claim of personal potence: the ability to change lives via use of software they are developing. Statements about making conditions better for oneself or another group (particularly users of the technology) or about affecting change in society were included here. A single statement of effectiveness could span beneficiaries, including the participant themself, the participant’s team, the organization, the intended users, broader society, and even the whole world. For products which are not yet completed, some of these statements are forward-looking or predictive of future impact, interweaving the identity functions of effectiveness and ideal identity.

- Expression of impact on self:
    - “I wouldn't describe myself as emotionally attached to the product, beyond the satisfaction of cleaning up a messy problem with an elegant solution that I'll be able to use later.”

    - “My whole life has been related to technology and thought that if you pay for something with your hard earned cash that then becomes yours..and not being able to customize a device the way I see fit or add modifications to the software so it makes my life experience better with that product then I should have that choice and with apple they do not give you that option thats why I put my focus on jailbreaking”
    - [...] It's not the most interesting thing to be building, but it will enable a lot of people, including me, to spend more of our time working on more interesting things[....]
- Expression of impact on the team:
    - “It means a lot to me since the product has been used by our team for many years.”
- Expression of impact on the organization:
    - “The system I'm working on is a tool that the broader company needs pretty badly. It's not the most interesting thing to be building, but it will enable a lot of people, including me, to spend more of our time working on more interesting things.”
    - “It was a huge success and has boosted our bottom line”
    - “Fixing thing people need to keep company up and running”
- Expression of impact on the user base:
    - “This product will help save lives improve health and make jobs in life easier in the healthcare industry”
    - “Everything we do helps our endusers accomplish something and that is very rewarding”
- Expression of impact on society at large:
    - “I think this project is very important to the world because it will change how people feel and interact with one another.”
    - “[...This] work contributes to human knowledge and I like that.”
    - “The team wants to make the world a better place, and our product will be successful in doing so”

Conversely, we would expect someone who sees a tool used to harm others to have to deal with guilt, whether or not that guilt is actually justified. This negative aspect of effectiveness did not emerge in the data. However, with scientific and social critique of technologies such as

artificial intelligence (AI) and social media, it seems highly unlikely that negative expressions of effectiveness do not exist. This is an area for future research.

Another negative function of effectiveness would be shown in expressions of inadequacy or inexperience with the material, or personal stress during project setbacks.

- "This is a new project for me and I really haven't begun to get the ball rolling."
- "When setbacks happen it impacts me greatly and can weigh on me."

Finally, perceived inadequacies in the product may also trigger a negative sense of effectiveness, as project team members deal with their role in a failed project or an underperforming one. Since the data was collected primarily for ongoing software projects, it would seem unsurprising that references to actual project failure did not emerge, but references to the consequences of possible future failure did.

- "It doesn't mean much to me at all. It's a new feature that I don't think will actually be useful"

In summary, while indicators in the proposed IT identity measurement model preferred control of the development process for the product, the qualitative responses offer a much more expansive view of the importance of the effectiveness function for project team members. These findings indicate several new ways in which indicators for the effectiveness function can be crafted, and also suggest tests which separate effectiveness into multiple sub-functions. It is possible that while some subcategories of the effectiveness function serve as antecedents, others may serve as direct indicators of an IT identity. In addition, there are strong indications of dis- and anti-identification which can be explored in future research.

5.5.2 *Emotional Regulation (and Emotional Energy)*

The emotional regulation function most closely overlaps with one of the existing indicators of IT identity: emotional energy. While the two are closely related, it seems reasonable to expect that the emotions felt towards a product under development differ from those felt towards a consumer purchase.

While responses were analyzed using inductive and deductive qualitative text analysis, another potential option was sentiment analysis, which is a quantitative form of text analysis where words are weighted for their emotional content and blocks of text analyzed for their overall sentiment. During this research, a trial run was performed using Sentiment, "a Node.js module that uses the

AFINN-165 wordlist and Emoji Sentiment Ranking to perform sentiment analysis on arbitrary blocks of input text" (Sliwinski, 2013, p. 1). Initial evaluation of the results showed dubious utility to this work, and computational sentiment analysis was rejected for this project. A quantitative approach may still be of use in future analysis of emotional regulation and emotional energy indicators for IT identity taking place in other contexts.

During the card sort phases of the creation of the proposed measurement model, emotional regulation confounded many candidate indicators for other identity functions. The common use of "feel" as a synonym for "believe" or "perceive" caused sorters to classify candidate indicators as emotional regulation rather than their intended category. For example, the ideal identity candidate measure "The product helps me feel more like the person I want to be" was edited into a new form "The product brings me closer to the person I want to be" to remove the emotion-indicating word "feel." The same propensity to interpret "feel" as an indicator of emotion is obviously present for the evaluation of participant statements as it was for the evaluation of candidate indicators. The word could rather be an attempt to express an intuitive understanding or belief rather than an emotional response.

The multiple meanings of "feel" complicate analysis, too. The following quotes include variations on the word "feel" but were classified as effectiveness and not emotional regulation: A belief in one's competence represents self-efficacy and effectiveness, and the emotional regulation function seems minimal when viewed from that perspective.

- "It means that I make a lot of money training it and that I feel competent which is good"
- "A feeling of success"

The following also use the word "feel" but with its "believe" meaning, and were not classified as exhibiting the emotional regulation function:

- "I feel it could be a giant step for me in becoming independent should we succeed."
- "It's been a big part of [my] life for a couple of years now. I feel I'm defined by the product now."

In plain text, identifying the strength of emotion can be difficult. Initial evaluation of statements such as "I enjoy it", "I enjoy using it" and "I enjoy it greatly" were inconsistent, and iteration was required to standardize coding. Mild expressions can be indicative of dis-identification, and it can be difficult, situationally, to determine if an expression is "emotional enough" to indicate the presence of the emotional regulation function. Statements with stronger,

more expressive language (“love”, “excited”, “awesome”; “passion”; “dream goal”) were coded as emotional regulation and emotional energy.

A set of respondents write in highly emotional terms about their relationships with their products; These statements all also happen to represent the relatedness dimension of the existing measurement model, consisting of highly emotional expressions of connectedness to the product.

- “I love it and it's my life”
- “It’s what I like to do it’s my life”
- “It's my heart and soul“
- “It's blood sweat and tears I put in a lot of man hours to get this finished”

For others, emotional regulation comes through the perceived positive emotions of their users, a function of having created technology which does not seem to have a parallel for consumed goods.

- “Well it's makes people heathy and happy not only do I love seeing results but also love seeing my clients have a smile on their face.”
- “It's an avenue of happiness, and a change agent for good, for those users who are blessed enough to live in a situation that affords them the access to technology such that they can participate.”

One important recurring emotion was pride, either for the product itself or in the efforts made by themselves and their teams. Pride is an emotional response that we might not expect to find when investigating IT identities involving consumed IT, where much of prior IT identity work has focused. Whether the object was acquired or built, pride is often from the personal investment required.

- “Proud of the delivery”
- “It means a lot and I have a lot of pride in the product”
- “The product is a direct representation of what the group effort has come to. We are very proud of what has been created.”
- “I'm proud to say I was part of the team that worked on a successful video game, but it's not exactly the game I would have chosen to make. I'm proud of the technical challenges I personally solved.”
- “It's a product I personally use and feel proud to have contributed to. I read user reviews regularly.”

- “It's important to me because I [worked] on it so hard, I can be proud of it.”
- “It's my tech baby and my teams also I'm proud of my guys more”

Future work on indicators for IT identity would benefit through specific investigation of feelings of pride, especially as a differentiator between IT creators and IT consumers. This could be particularly enlightening if examining individuals who feel pride in work that was considered a failure by organization management, since it would further our understanding of the role of the “success” of building efforts in self-identification with material goods, as theorized in literature on the IKEA effect (Norton et al., 2012).

Five comments used negative emotional terms to describe the relationship with the product, once showing positive and negative (ambivalent) emotional regulation:

- “It’s stress, anxiety, hardship, growth, confidence and independence all rolled into one for me.”
- “When setbacks happen it impacts me greatly and can weigh on me”
- “It means I earn a paycheck. The product isn't something I really care about and I should find a different job.”
- “I spend my time and patience with this produce”
- “At this point, I'm ready to move on and try something new in an entirely different area of the business. We've been through a number of leadership changes that have made the project extremely challenging.”

One individual looks forward, anticipating emotional regulation when the project reaches its successful completion:

- “I need success to feel validated for the time, energy, and effort that I have put into the product.

In summary, emotional language featured heavily in participant responses. Care needs to be taken to differentiate between the multiple ways in which statements of “feeling” can be found to apply to multiple identity functions and dimensions. “Pride” featured prominently enough that it should be considered in the future creation of emotional regulation indicators. Acknowledgement of negative emotional responses and examination of their relationship with self-identification should also be considered.

5.5.3 *Actual Identity*

During the creation of the new IT identity measurement model, quantitative indicators for the actual identity function focused on feelings of interrelatedness with the product. The new indicators each suppose that understanding the product under development will help others understand the team member.

More broadly, the actual identity function is defined as a means for an individual to show others who they are through the object. As an expression of their uniqueness as an individual, this is usually considered an expression of a person identity rather than a material identity, but material goods can also be a means of exhibiting those traits.

While the prompt for this section of the survey regarded what the product means to the participant, several participants responded with descriptions of themselves, explaining who they are.

- "I am very much connected with all the process"
- "I dedicate most of my hard working hours making this product work and happen."
- "I take my job very seriously."
- "I consider myself a person who likes to turn everything on time."
- "I overall manage the product once implemented."

"I am… " statements are particularly strong statements of identity, to the point where a common tool for surfacing identities is a Twenty Statements Test where individuals are asked to complete the prompt "I am…" twenty different ways (Kuhn & McPartland, 1954). Here, when asked about the product, participants choose to make these sorts of statements. Re-phrasing the set above, we see: "I am connected…", "I am dedicated and a hard worker…", "I am serious…", "I am punctual…", and "I am a manager." With a more interactive data collection methodology, such as an interview, these statements could be better surfaced in this powerful "I am…" form.

Other responses do more directly refer to the product. Three use the word reflection, as if people looking at the product are given a view of the participant. Each of these statements is a means of explaining who they are by explaining their relationship to the product.

- "Personally, it's a reflection of my work ethic. I think the way it runs, and what it does is definitely a good representation of how I run, manage and operate my teams."
- "This product has become a direct reflection of my IT skills as a developer, analyst and chief director showing off my skills, training, expertise and problem solving skills."

- "The product reflects me and my team members hard work and dedication to our work and success."

No candidate measure for the new measurement model used "reflect" language. Future research may choose to test this language for actual identity indicators.

While not a direct reflection, this individual also expresses a public link to the product as well as a public responsibility for the product.

- "It means that I stand by it and therefore I try to make it even a better product."

One participant bluntly states that their actual identity is directly linked to the product: Others understand who this participant is because of the product they built.

- "It gives me identity. People recognize me for the product I built for them."

Since IT identity is theorized as a form of material identity, care was taken when writing candidate indicators to focus on the product and not other aspects of the development environment. Still, there is an obvious inclination for an individual to associate the product with their job, and jobs are strongly tied to role identities. A job, career, or source of livelihood is an extremely common, strong role identity for any individual. The income afforded by a job may be tied to the effectiveness function in an individual's life outside of work. For individuals who create as part of a career, the products they create can serve the actual identity function. Of course, dis-identification and anti-identification are also possible. Often, the implication is that work on the product is just a job and no more, expressing a disassociation between work and life, or between work and the product. Finding distinction among the possible variations can be difficult with short responses, but sometimes participants provide enough context for distinction.

- Identification
  - "It's great I love it and my job
  - "My job and source of income mostly depend on this product and I want to help make it good for the consumer
  - "The product to me is like my baby and it is my lively hood"
- Anti-identification
  - "The product isn't something I really care about and I should find a different job."
- Dis-identification
  - "It's my job. They pay me to do it."
  - "I just do my job"

    - "my job depends on it"
- Ambivalent identification
    - "It's my livelihood it is either the hard work for a paycheck or it's me out looking for a job in the ad section"
    - "The product is just a means to an end meaning I enjoy what I do but at the same time I'm getting paid for it and I'm not my own boss I work for a company in an organization"

In summary, participants did show strong evidence of the actual identity function by explaining who they are in direct terms of the product, and by indicating its part in professional role identities. In addition, there are strong indications of dis- and anti-identification which can be explored in future research.

5.5.4 *Ideal Identity*

The ideal identity function is future-looking. It is about recognizing or imagining a more ideal self, either through or with the product. It reveals what an individual aspires to be.

When crafting later-phase candidate indicators for the ideal identity function, care was taken to make the possible ideal self-image indistinct, referring to "who I want to be" and "my ideal self" rather than to specific possible ideals. This was an intentional attempt to allow participants to project their own ideal future self into the question, rather than asking about one specific area of improvement which might not be universal among participants, or about several areas for improvement which might split indicators and lead to lower reliability scores among candidate indicators for this function. Participant responses allow us to see the sorts of ideal identities envisioned by project team members.

Statements involving the ideal identity function often contain projections of future, unrealized effectiveness functions: a future state where the participant has greater knowledge, skills, responsibilities, or autonomy. For example, these participants see the product as an opportunity to expand their job skills.

- "I got into this product because it was something I enjoyed greatly. But nowadays it's a big continuously evolving puzzle. Once you solve one part, another kind of puzzle comes up. This keeps stretching me into new skills to get a handle on the problems, so it continues to be a learning experience."

- “it is a good way to expand my skills”

These individuals are not as concerned with learning new skills as the opportunity to show off existing skills.

- “it gives me a chance to rank higher along the chain and prove to everyone that I have the knowledge of what the company wants”.
- “That I can be trusted to lead on future developing by my team and that feeling is priceless.”
- “If I make the right decision it looks good on me”

Other comments indicate a better future outside the company should the product succeed.

- “I feel it could be a giant step for me in becoming independent should we succeed.”

While a destiny can be either positive or negative, an individual who would tie their destiny to an IT product is either strongly identifying or dis-identifying with it.

- “It means my destiny to do it.”

The ideal identity function is also defined as including repairs to actual identities, so statements of self-improvement exhibit the ideal identity function even if not explicitly forward-looking. Whether or not the following statement is reflective or predictive, it fulfills the ideal identity function.

- “Growth and perseverance”

These examples have all pertained to a direct relationship between the participant and the product. A different trend in responses involved the potential to change society or the world with the product. In effect, participants claim to be making change they want to see in the world by participating in product development.

- “It means that we are focused on the future and working together to heal our country”
- “It’s a product that helps the world grow”.
- “It is my life's goal to make this happen. The team wants to make the world a better place, and our product will be successful in doing so”
- “The product means the potential to leave a lasting mark on humanity as a whole going into the future.”

Other participants seem hesitant about the future, using hedging language in their statements. Each statement leaves open the possibility that the project might fail, causing identity damage.

- “It would be tge epitome of my developing carreer. Last hurrah”

- “The product essentially is my life right now. Until we go to market this has been my baby for years and years. I need success to feel validated for the time, energy, and effort that I have put into the product.”
- “The product is very important because it will affect my job asa whole. If I make the right decision it looks good on me.”
- “This product is a game, and it is also our capstone project for our college career. I'm invested in the success of this product and have done everything I can to give my best in hopes of a positive outcome.”
- “I enjoy it, it's helped me make friends. I also think it could be much better and wish to help it become so”

Since they are forward-looking, we cannot tell if the success or failure condition would lead to a change in the strength of self-identification with the product, or even anti-identification. Future longitudinal research into project teams and IT identity would be required to show these patterns, tracing strength of self-identification with the project, anticipation of project success or failure, and final project outcomes.

As we will discuss further in the relatedness section below, five participants explicitly call the product their “baby” or “child”. These statements were not classified as IID even though they may be seen as implying a future state for themselves and the product. While IT identity is theorized as a form of material identity, these statements would seem to cast the participant in a “parent” identity, which is a role identity. It is unknown if research on IT identity as it regards IT use and adoption would have reason to consider parent identity standards as part of self-identification with consumer technology (despite the obvious implication of the word “adoption”). Also, the identity-related functions of material goods come from consumer identity research, where it seems to be less common but still possible that parenting analogies would emerge between a consumer and a purchased item (dolls, pets--including digital pets, such as Tamagotchi--or high-maintenance luxury goods). This theme holds promise for future research into a creator’s self-identification with their creation.

5.5.5 *Personal History*

Where the ideal identity function is forward-looking, the personal history function provides a sense of continuity of self with the past. Personal history functions were not strongly represented in

participant responses, and were best modeled as an antecedent to an IT identity with the product under development during model development.

Early rejected candidate indicators for the personal history function attempted to invoke trophies and mementos, but were deemed insufficiently focused on the current product (for which the indicators are intended to apply) or overly complex (which could lead to undesirable cross-loading with other functions). Others were chronologically confusing, mixing past and present, and had the "feeling" language problems as well (e.g., "I feel this is the sort of product to which I've always wanted to make contributions.").

The final candidate indicators focus on ways that the product may serve as a reminder of the past for the participant, specifically using "reminds" language in each. Deeper investigation of the personal history function, nostalgia for past technology, and memento-keeping among project team members still seems like fertile ground for investigations into IT identity, but are future work.

Participants varied in the ways in which the personal history function was enacted. One participant specifically mentioned pre-employment use of the product, which happened to be a digital game.

- "The product is a game that I have played for eight years now, three of which as an employee working on it. It is the ideal genre blend for me and probably the game I have played the most in my entire life. (~5000 hours)"

Other participants gave no indication that they had pre-employment connections to the product, but did feel express connections in terms of the length of time they have been associated with the product, team, or organization.

- "I've been working on getting this company off the ground for over a year, so I'm very personally invested."
- "I've been working with my team and the product for 4 years so it means a lot"
- "It's what I've been working on for years"
- "It's blood sweat and tears I put in a lot of man hours to get this finished"

In the absence of long-standing experience with the product, some participants expressed their current work as a continuation of their work history in terms of similar products they had worked on.

- "On a more emotional level, I spent a lot of my audlt life working on bespoke single session games where the only measure of success was whether or not a group of frankly

eccentric players liked what I did. It feels good to be able to take the skills I learned doing that and apply it to something more wholesome. [...] Also, no one yells at me when I run wargames for national security, something that cannot be said of the hobby game industry."

- "The product is like a combination of things I used from my past engineered into something new"
- "This product [...] reminds me of older days in the IT field and feeling a part of something great."
- "Working with Sony playstation coding is my life I've been doing this for years and I wouldn't be myself if I wasn't in this field."

For other participants, the expression of personal history wasn't through product types, but instead connected to their past selves in terms of skills used.

- "The product is new, so it's a chance for me to demonstrate my skill and experience at an earlier point in most projects I've worked on."
- "I'm getting to the end of my career, at least full time, and my current project is a chance to end on something really challenging and fun with a bunch of great people that I think will be successful"

Two participants made statements that strongly connecting the ideal identity function with the personal history function by making statements about how the current product had the potential to fulfill long-standing aspirations, while a second sees those past aspirations fulfilled by a completed project.

- "It's like everything I've wanted to be a part of and finally came to life."
- "This product is something I dreamed of making for years and now that it's a reality icant believe it"

Few of the comments classified as performing the personal history function indicate whether the product is seen as successful, and there is little room for claims regarding the relationship between the personal history function and product success. However, as many of these comments imply investments of time, a phenomenon known as escalating commitment may be in play. Escalating commitment is tied to the sunk cost fallacy, which is the tendency to continue to invest in troubled projects—even accelerating investment—due to an unwillingness to "give up" on resources and effort already invested (Keil et al., 1994). One comment does directly seem to apply:

- “It’s my baby and a project I’ve put all my energy sweat and tears into. I believe in it completely and know it will succeed and if it doesn’t we will keep going until it does”

Since identities tend to be systems for maintaining a sense of self, identity theories would seem to imply that individuals who have invested effort into a product and who have formed an IT identity with the product would be reluctant to change those identities, creating the sorts of continued bad investment of effort as is suggested by research into escalating commiment.

While there is little solid evidence of dis-identification or anti-identification in the personal history responses, one participant reflecting on their history with the product also indicated that it is time for a change.

- “It's been a significant part of my life. At this point, I'm ready to move on and try something new in an entirely different area of the business. We've been through a number of leadership changes that have made the project extremely challenging.”

For the personal history function, the important aspect of this last excerpt is the first sentence where the participation states their appreciation of the significance of the product in their life. The latter two sentences may be an indicator of ambivalence or the beginning of a change from identification to anti-identification, but there is too little clear evidence for a judgment. Invoking management as a catalyst for this possible change in self-identification has implications for the social interrelatedness function (or, possibly, the social identity function) and will be re-examined in social interrelatedness below.

5.5.6 *Symbolic Interrelatedness*

The symbolic interrelatedness function was excluded from the creation of the measurement model due to the difficulty in determining which “other” the indicators should involve. Despite this, each statement was evaluated to see if it expressed the presence of the symbolic interrelatedness function. It was the least-identified function of the set, but did appear six times.

Two responses used the word “friends” which seems to indicate a set of one-on-one relationships more than a group identity.

- “I enjoy it, it's helped me make friends. I also think it could be much better and wish to help it become so”
- “It is important to me i get to learn new stuff and spend time with friends”

Others could be interpreted as either relationships to individuals or groups, or job functions that seem to necessitate interpersonal relationships (collaboration and mentorship).

- “It doesn't mean anything to me, personally. The people do, but not the product.”
- “Its a creative, collaborative, and passionate environment [...]”
- "I'm getting to the end of my career, at least full time, and my current project is a chance to end on something really challenging and fun with a bunch of great people that I think will be successful[....] It is a chance to mentor and help develop some very talented people."
- “It is fun to share details about in conversation with everyday folk”

One comment, reviewed above for personal history functions, includes possible negative statements regarding symbolic interrelatedness.

- “It's been a significant part of my life. At this point, I'm ready to move on and try something new in an entirely different area of the business. We've been through a number of leadership changes that have made the project extremely challenging.”

The specifics here are unclear, and we cannot be sure if “leadership” here is project or organization leadership. Both are considered vital to successful projects: competent project leadership is an obvious factor but project management research also tells us that management support is an important contributor to project success. Here, this individual seems to be in the process of dis-identifying with the product due to problems with one of these two.

While these few comments do indicate possible avenues for future study of symbolic interrelatedness on project teams, their relative absence and lack of clarity in the full data set also validate the decision to exclude them from the measurement model.

5.5.7 *Social Identity*

The social identity function could pertain to any number of social groups involved in the software creation process. Depending on the project size, stakeholder groups for a project can include top management at the organization, the full project team, functional teams within the project, customers (those purchasing the product for themselves or others), end users (regardless of whether or not they personally purchased the product), government agencies exerting regulatory control, third-party contributor groups, other organizations, and more (Larson & Gray, 2018).

There were two groups for which the focus of social identity indicators were considered: The project team and the end user. Nearly all software development projects have these two groups of stakeholders in some fashion. While organization management may be present in most software development environments, that group was seen as less likely an indicator of self-identification with the product. It was theorized that a project team member who considered themself to be a member of the end user group would tend to have stronger self-identification with the product and tend to behave in a manner that preferred product spec to budget or schedule. It was also theorized that people creating digital games would tend to self-identify with the end users more than individuals working on highly utilitarian software. Theories parallel to these but concerning the project team were considered as strong, and the decision was made to test the social identity function with only one group to prevent over-complication of the measurement model testing process. For these reasons, all social identity candidate indicators focus on identification with this group.

The social identity function is apparent in statements where the individual presents themselves as a member of a social group or subculture, and is tied to the belonging motivation. Statements of membership are a particularly strong illustration of this function. Less strong but still applicable are statements that showed consideration (beyond simple mention) of what the product meant to stakeholder groups, since these statements still use the product as a symbolic link to a social group. These responses show a desire to help or support members of a group was foremost in their minds.

For each social identity statement, the stakeholder group was also identified. The three primary groups identified were the end users, the project team, and the parent organization. Mention was also made of friends, family, a business sector, the nation, and all of humanity. While most statements regarding extremely large groups seemed to be about users among those groups, others seemed to indicate that the existence of the product would even help those who were not users. Some complex statements were classified as social identification with more than one group.

The following sections provide analysis by group identified.

5.5.7.1 The End User - Stronger Function

A small number of participants declared themselves, specifically, to be users of their product, not in the context of other groups such as their team. The first excerpt was also used in the Personal History analysis, above, since the individual is a long-term user.

- “The product is a game that I have played for eight years now, three of which as an employee working on it. It is the ideal genre blend for me and probably the game I have played the most in my entire life. (~5000 hours)”
- “It's a product I personally use and feel proud to have contributed to. I read user reviews regularly.”
- “I will be using it so it means a great deal”

5.5.7.2 The End User - Weaker Function

A larger number of respondents used their product as a symbolic link between them and the user group without specifically mentioning their own membership in that group. These tend to take the form of effectiveness statements claiming the work as a means to exert a positive influence over the users.

- “Well it's makes people heathy and happy not only do I love seeing results but also love seeing my clients have a smile on their face.”
- “Everything we do helps our endusers accomplish something and that is very rewarding”
- “Helps the community gets stuff working better and faster”
- “Giving kids and adults as well a new and easier way to learn coding”

Also of interest here are a set of comments that seem to consider the whole world as beneficiaries of the product. The mildest (and most defendable) is a simple statement of scientific advancement.

- “Still, this work contributes to human knowledge and I like that”

Others make very strong statements about potential global impact and imply a universality of the product’s utility. Rather than referring just to their users, these participants use language that might include all of humanity.

- “So, to me, it means a sense of fulfillment because I get to be one of the people who will bring this to the world.”
- “It’s a product that helps the world grow. It helps humans connect with one another.”
- “The product means the potential to leave a lasting mark on humanity as a whole going into the future.”

If we consider the social identity function as an individual’s use of an object to represent an individual’s perception of their own membership in a social group—a group identity—then a

relatively small number of respondent statements would qualify. More commonly, they read as an expression of a role identity: A social role usually with a social counterpart, such as “doctor” and “patient.” For a doctor, a stethoscope may serve the social identity function, serving as a symbolic connection to fellow doctors, or it may serve as a symbolic connection to patients, a social role most of us take from time to time. In respondent comments, one seems highly illustrative, seeing themselves as separate but related to the product’s end users.

- “I’m over the end user of the product”

This assumes “over” is intended more in its meaning of “in charge of” than the alternative “done with”. The latter would indicate anti-identification, discussed below.

When considering the social identity function, it seems we must either allow our definition of the social identity function to include other forms of attachment (such as role identities), find another function that suits this phenomenon (none seem appropriate), or define a new function representing these other forms of self-identification (a role identity function). The broader definition of the social identity function seems to have the greatest utility.

5.5.7.3 The Project Team

Since this research involves project team members and the product they are developing, it is perhaps unsurprising that there are no statements making an obvious distinction between a participant and their team. Membership is implied in all of these statements. As above, I find a subset (two statements) involving actual use of the product.

- “It means a lot to me since the product has been used by our team for many years.”
- “It is a tool that was built by one group but is currently growing and always evolving. It is a great way to expend collaboration between teams”

Another subset of project team statements does not mention the utility of the product, only its symbolic importance to the group.

- “It's my tech baby and my teams also I'm proud of my guys more”
- “It is like a heart to me and my team”
- “That I can be trusted to lead on future developing by my team and that feeling is priceless.”
- “I’ve been working with my team and the product for 4 years so it means a lot”
- “Seeing the project being completed with the whole team working together.”

- “The product is a direct representation of what the group effort has come to. We are very proud of what has been created.”
- “my current project is a chance to end on something really challenging and fun with a bunch of great people that I think will be successful”

5.5.7.4 The Organization (Including Management)

For most publicly published software products, we would expect a product to serve as a symbolic link to the organizations that publish it. We also expect that a product under development could serve a similar function. Eight (8) comments mentioned the project team’s parent organization.

- “I promise to serve my company diligently”
- “To me personally the product is a way of showing my worth to the business, and a way of helping my business to be successful.”
- “It's been a significant part of my life. At this point, I'm ready to move on and try something new in an entirely different area of the business. We've been through a number of leadership changes that have made the project extremely challenging.”

5.5.7.5 Other Social Identity Statements

Other social groups appear in very small numbers of comments.

- Friends
  - “It is important to me i get to learn new stuff and spend time with friends”
- Family
  - “It is my main source of income. It helps support (financially) a group of people I care about as a class. It is fun to share details about in conversation with everyday folk, rather than a tool I think is too abstract or boring to flaunt.”
  - “Producing product means that I am employed and have the income to meet my family's needs.”
- An Industry Segment
  - “This product will help save lives improve health and make jobs in life easier in the healthcare industry”
- The Nation
  - “It means that we are focused on the future and working together to heal our country”

A small number of respondents mention social groups in the context of their product in a fashion that seems to indicate a dis-identification or anti-identification with the subject group. To these individuals, the product was "just a job", showing a mental separation between their team and parent organization.

- "The product is just a means to an end meaning I enjoy what I do but at the same time I'm getting paid for it and I'm not my own boss I work for a company in an organization"

Rather than focusing on the benefits of the product to the organization, one participant feared that the product might cause damage to the organization's relationship with the public. This is a statement of social identification, but is stated as a potential threat rather than a benefit.

- "The product is so important because if things go wrong, it will destroy our reputation"

If this technology is responsible for harming the individual's relationship with a desired social group, we can expect self-identification with the product to diminish or even become negative.

Another self-identified with their team or organization, but plainly stated that the product is not serving the social identity function.

- "It doesn't mean anything to me, personally. The people do, but not the product."

In terms of the measurement model, focus on the end users seems to have been justified by the high number times the social identity function was invoked in association with that group. A tech worker's self-identification with their own project team is of obvious importance, and future work regarding the correlation between an individual's self-identification with their team and the product appears justified.

5.5.8 *Meaning*

In theorizing connections between identity-related functions of material goods and identity motives, Dittmar (2011) chose not to draw a connection between the meaning motive and any function. In a very real way, all identity functions involve meaning-making: All of the functions analyzed above were in response to a question about the meaning of the product. Theory behind the meaning motive tells us that humans create and maintain identities so that they can feel "that their lives are meaningful" (Vignoles, 2011, p. 403), indicating "the need to find significance or purpose in one's existence (Vignoles, 2011, p. 417 summarizing Baumeister, 1991). While the survey prompt specifically asks what the product means to the respondent, many represent the

product as a major (or definitive) source of meaning in their lives. indicating that the participant felt work on the product provided that significance or purpose. The samples below represent 26 different versions of the same sentiment.

- “Everything because it's really necessary and important to have”
- “It means a great deal”
- “It means the world to me”
- “It’s means everything”
- “It’s my life”
- “Life or death”
- “My product means everything to me it means success, authenticity, abundance and creativity.”
- “This means alot to me so thanks”

These statements occur at least once for every product type included in the survey, including six (6) times for business-to-business products among the fourteen (14) statements attached to categorized products. The reader of these statements can assume some hyperbole, but more than 10% of participants have chosen to state that their lives have considerably less, little, or no meaning outside the product they are building. The identity functions which were used as a basis for analysis in this section come from consumer research. It may be highly unlikely that a purchased item would commonly serve a strong meaning-making function for the whole of someone’s life. In these statements, however, meaning-making emerges as an identity-related function of software products for those who create them, despite its omission from consumer research. This is a significant finding, expanding our understanding of material identities beyond the narrower topic if IT identities. In future work, candidate statements like the following may produce additional insights: “My life would be less meaningful without the product (Strongly Agree to Strongly Disagree)”.

5.5.9 *Relatedness*

One aspect of relatedness is the blurring of an IT’s affordances with one’s own capabilities. In these samples, though, we see that the product is a representation of the respondent’s traits and capabilities.

- “This product has become a direct reflection of my IT skills as a developer, analyst and chief director showing off my skills, training, expertise and problem solving skills.”
- “Personally, it’s a reflection of my work ethic. I think the way it runs, and what it does is definitely a good representation of how I run, manage and operate my teams”

These samples are statements of effectiveness that are also stated as relatedness: The product is a mirror, but what is reflected from the participant is their skills. Another suggests, metaphorically, a spatial relationship, describing themself in direct proximity to the product, suggesting that others will view the product and participant as closely related.

- “It means that I stand by it”

Other relatedness comments use actual familial terminology. Eight respondents referred to the product as their baby or child.

- “It's my baby”
- “It is a major project so it is my baby”
- “The product to me is like my baby and it is my lively hood”
- “It's my tech baby and my teams also I'm proud of my guys more”
- “It’s my baby and a project I’ve put all my energy sweat and tears into. I believe in it completely and know it will succeed and if it doesn’t we will keep going until it does”
- “Until we go to market this has been my baby for years and years”
- “with products i have a better relation like a son and mother”
- “it is like my children”

Still others refer to the product as a physical or spiritual part of themselves. Eight respondents used a form of “it’s my life” as their response, while five others acknowledged it as part of their lives.

- “It’s my life”
- “I love it and it's my life”
- “It is a part of my daily life.”
- “It's been a significant part of my life”

Others used “heart” and even “soul” in their responses.

- “I poured my heart and soul into the project over the last 6-8 months. The projects success is my life’s success”
- “It is like a heart to me and my team”
- “It's my heart and soul”

- "It's a game I created and I put my heart into in all aspects"
- "The product means a great deal to me. I put my heart and soul into the projects that I am involved with. Doing what I can to make the product a reality is important to me."

These relatedness comments work bidirectionally. Some state that the product is their heart, implying an internalization. Others externalize the reference, explaining how they put part of themselves into the product. Both are intimate statements of relatedness, but there are theoretically important distinctions in their implications for association with identity-related functions of material goods. Statements like "It's my life" and "It's my heart and soul" can be interpreted as statements of actual identity, explaining who the respondent is via the product. Statements like "I poured my heart and soul into the project" are explaining their effectiveness on the project in terms of how much of themselves they have given to it. Both can inform future indicator development.

5.5.10 *Dependence*

The dependence dimension of IT identity was a major motivation for this work. In prior work on IT identity, dependence is the feeling that an individual can rely upon the affordances of the IT in their day-to-day life. However, it seems unlikely that an individual working on early development of a product (when the features aren't developed or remain buggy) or making a product for others would feel they can depend on the product in ways that IT identity's use and adoption mindset suggests.

There are almost no expressions of personal reliance on the product for whatever functions it affords. Exceptions to this include:

- "It means that we can access files more safely on our devices"
- "I will be using it so it means a great deal"

Other specific mentions of product affordances are not personal, instead having functions afforded by the product to others as a sign of personal effectiveness.

- "I take pride in our backup success rate"
- "Fixing [the] thing people need to keep company up and running"
- "it's really necessary and important to have"

The first seems to indicate emotional regulation and emotional energy due to others' reliance on the product. The second is a statement of personal effectiveness mixed with organizational reliance. The last is a nearly universal statement of dependence.

As discussed in Relatedness, above, some participants wrote about the product in terms of their own heart or soul. Comparing the product to a vital organ seems to be a statement of reliance and relatedness.

One statement seems to paradoxically show a reliance on the product for personal independence.

- "I feel it could be a giant step for me in becoming independent should we succeed."

This participant is basically stating, "I'm relying upon the product to make me independent." Most statements of dependence conflate reliance on the pay provided from work on the product rather than the product itself, as expected. At times, this feels like a negative statement indicating anti-identification

- "my job depends on it"

5.5.11 *Summary*

Answers to the open-ended survey question on the meaning of their product to the participant was analyzed deductively—using the list of identity theories and IT identity dimensions—as well as inductively. Importantly, the sub-set of identity function concepts represented in the final measurement model were also reflected in the open-ended answers. In addition, these answers showed there is a larger array of identity functions that are activated for product team members.

In terms of the effectiveness function, their products allowed participants a sense of control and afforded an opportunity to show their competence to others in the organization, as represented in the measurement model. While building the measurement model, it was assumed that competence effects would be primarily personal or team- and organization-focused. The open-ended answers revealed that participants used the product to have an effect on a variety of other stakeholders outside the organization: Their perception of personal effectiveness was shown in the impact they saw or predicted for the public.

Analysis showed that the emotional regulation function (and emotional energy dimension) featured heavily. While the word "feel" was removed from indicators to minimize cross-loading between emotional regulation and other functions, participants used it liberally, complicating analysis. As with effectiveness, the inward-looking expectations for the function were joined by outward-looking instances, where the emotional regulation was experienced vicariously as the

primary emotional benefit was for others. The most common emotion mentioned was pride, which suggests possible improvements for emotional regulation indicators.

The actual identity function was seen as participants described themselves when asking about the meaning of the product. Variations on the word "reflect" and its synonyms suggest language improvements for measurement model indicators, as well as the metaphorical position of "standing by" the product.

The forward-looking ideal identity indicators in the measurement model were also personal in focus, dealing with self-improvement during the work. One also mentions influence on the field. These amount to projections of future effectiveness, improving oneself and the field. What emerged included future opportunities to show competence with existing skills, and the opportunity to create a better future for other stakeholders, including the entire world. Figurative references to the product as "baby" or "child" also present new opportunities for framing indicators as team members watch their figurative offspring develop and "grow."

Indicators for the personal history function assumed that historic ties would not be to the software under development, and that the product would be providing ties to other software in the past. This did appear, but many individuals were performing additional development on released software, providing historical ties to the product itself. An extensive history with the product is theorized to have a connection to escalating commitment to it.

While social identity functions were aimed at perceived membership in the target user group, several other stakeholder groups emerged: the project team, the organization (including management), friends, family, industries served, the nation, and all of humanity. Stakeholders such as the project team and organization would seem common enough for development projects to consider as part of future revisions to the measurement model. Latter entries in the list may be too specific for many forms of software development, but provide ample evidence of the importance of social identity functions for the participants.

One important emerging category involved statements which showed that the product was a source of larger meaning in the participants' lives. While literature does not include meaning-making as an identity function unto itself, the open-ended responses suggest that it should be considered. It is possible that meaning-making as an identity function is rare in regards to consumer research (where the identity function list was theorized) but more prevalent in the project management and technology development domains.

While the focus of the measurement model was positive self-identification with the product, participants also displayed attitudes indicating other identification quadrants from Figure 3.3. These statements provide insights that can inform future research into ambivalent IT identities, anti-IT identities, and dis-identification with IT.

5.6 SUMMARY

This chapter includes the findings of multiple examinations of IT worker self-identification with the product they are making. Exploratory SEM has produced a measurement model for IT identity that exceeds the explanatory power of existing models, showing relationships between IT identities and attitudes towards schedule and budget, but no relationship for scope. However, quantitative analysis of attitudes towards the iron triangle criteria show high concern for all three, and qualitative analysis of open-ended responses show the greatest concern for scope.

Qualitative analysis of open-ended responses to an inquiry about product meaning offers new approaches for the creation of identity indicators which, through a need for internal reliability, tend to become more narrowly focused during exploratory SEM. While perhaps less richly explored than through interviews, these responses did include the breadth of identity functions, further validating their use in IT identity research. For each function, analysis revealed new paths for the creation of improved indicators which, through a need for internal reliability, tend to become more narrowly focused during exploratory SEM. Importantly, meaning-making emerged as a strong identity function for products among their creators, expanding our understanding of the identity-related functions of material goods.

Participants also reveal the presence of dis-identification, ambivalent identification, and anti-identification in most entries, informing future research into the ways in which these other forms of self-identification might impact project team member attitudes and behaviors.

Chapter 6. DISCUSSION

This chapter focuses on implications of this work for research and practice, potential future work on the topic, and limitations of the work, as well as concluding the whole work. This research advances IT identity research in general, but more importantly begins a new sub-domain regarding tech worker self-identification with the IT they are creating. Special attention is given to validating and refuting portions of the Theoretical Model for IT Identity and Development Team Members (see Figure 3.5).

6.1 Implications for Research (and Future Work)

This work expands our theoretical understanding of identities, particularly material identities and specifically IT identities, by presenting and testing a theoretical model of the phenomena regarding the formation and enactment of IT identities in the context of IT project work. Prior exploration of IT identities had focused on adoption and use of technologies, while this work extends our understanding of IT identity to the domain of technology creation. The work also links theory on the identity-related functions of material goods to the domain of IT creation, and finds that, at least in the case of developer self-identification with the product they are creating, a measurement model utilizing indicators based on identity functions outperforms the existing IT identity measurement model. More broadly, it finds that meaning-making is an important identity function of technology for its developers, expanding our understanding of identity functions.

Below, this section reviews, summarizes, and discusses the findings from this research, explaining their implications and indicating future areas for research—organized by entity in the Theoretical Model for IT Identity and Development Team Members (see Figure 3.5)—before addressing additional topics.

6.1.1 *Experience*

During the exploratory SEM phase of this work, two identity functions (effectiveness and personal history) were found to model well as antecedents to tech workers' IT identity regarding the product under development. Since the Experience category of the model includes Work History and Experise constructs, exploration of these portions of the model are supported by the data. The indicators that emerged favored competence over control. While evidence suggests that agile

development methods, which were in use by 61.3% of the respondents, requires that team members take more initiative in problem solving than in more top-down development environments, the data also included individuals who actively tried to avoid problem-solving, declaring that decisions were made by those above them on the organization chart. This suggests that competence is a more universal expression of the effectiveness function. The experience that comes from personal history with similar products builds the expertise required to effectively contribute to the product.

In terms of the original adoption-and-use framing of IT identity, there were very few examples of self-identification with the technological tools required to develop software, such as bug tracking software and integrated development environments. As stated in Chapter 3, self-identification with tools was expected in the data. This obviously does not mean the phenomenon is not present in the field, and its absence points to the potential for future work to specifically investigate the presence of this form of IT identity and relationship between self-identification with the product under development and the tools being used to develop it, as one may moderate the other.

The Actualized Rewards construct was not specifically investigated in this research project and represents possible future work.

6.1.2 *Product Characteristics*

The Product Characteristics category includes Goods Type, Intended User, and Feature Set constructs. Of these, the Intended User construct was most heavily analyzed, as it ties strongly to the social identity function (SID) which focused on self-identification with the target user group. What emerged from the data, though, is SID as a reflective indicator of IT identity, not as a moderator of elements from the Experience category. (Moderating effects were tested during exploration of the model, but were quickly rejected and the process not deemed sufficiently important to the end model to include all details in this work.)

While information on Goods Type was gathered (via the Software Type questions in the survey) sample sizes among categories were insufficient for multi-group analysis given the degrees of freedom in the emerging model. Goods Type, ranging from more utilitarian to more hedonic, was theorized as an important factor in the formation and strength of identities regarding the product, but remains largely unexplored in this work. Exploration of the effect of Goods Type on IT identity must be future work.

The Feature Set construct is, essentially, the product specification. Findings here do not indicate any significant relationship between a worker's self-identification with a product under development and the importance they attribute to its spec. This finding is surprising. For an incomplete project, a specification should be a clear representation of what the product will be. During research planning, it was expected that IT identity and concern for the product's feature set would be most strongly correlated. At the same time, a clear positive relationship exists regarding the strength of an IT identity and attitudes towards both budget and schedule for the project, which do not formally appear in the new theoretical model except as attitudes that affect Behavior caused by an IT identity with the product. It is possible that the simple representation of attitudes towards the spec are simply insufficient to work well in the model. Regardless of the cause, the nature of the relationship between the specification to which a product is being built and worker self-identification with that product merits considerable future work.

6.1.3 *Situational Influences*

The Situational Influences category was largely unexplored in this work. In the future, SID indicators focusing on identification with the product team and the organization may provide further insight into the validity of these constructs in the model. Opportunities and Support is tied to organizational traits, like the availability of training, policies, and infrastructure to support the IT identity, and interpersonal ties (which point toward the symbolic interrelatedness function (SIR) that was rejected early in the measurement model creation process). SIR was rejected because a sufficiently common "other" could not be designated as the focus of the indicators, and SIR was identified infrequently during qualitative analysis. This work provides little incentive to pursue interpersonal ties in future work---which was pursued and abandoned---while organizational traits were not pursued and may prove fruitful to future researchers.

6.1.4 *Psychological Ownership*

Psychological ownership is not tied to identity functions, and so was unexplored in quantitative analysis. Further, it did not emerge as a theme during qualitative analysis. Responses that included possive words ("my" and "our") tended to indicate the team and not the product. However, psychological ownership remains a potentially important component in the theoretical model, and merits future work. The overall design of the research would have been improved by the inclusion

of at least one question regarding feelings of ownership of the product that could have been used as a DV during the exploratory SEM.

6.1.5 *Behaviors*

The Behaviors category includes constructs for Decisions, Support, and Resistance. Since specific behaviors were considered insufficiently common for inclusion in the survey, iron triangle attitudes were used to operationalize constructs in this category.

Worker attitudes towards the iron triangle success criteria have not been thoroughly explored in the past. The literature review regarding risk factors found that existing research focused on workers' skills and their attitudes regarding team and organization, not their attitudes regarding project success criteria.

Broadly speaking, this approach did not deliver as expected. The profession of project management has long focused on the iron triangle as success criteria for projects, but attitudes towards the three did not model as a group. The relationship between IT identity and attitude towards the product's scope was not statistically significant in the emerging model. Many respondent comments involved concepts related to benefits realization and portfolio management rather than project management specifically. Overall, the project's DVs represent a fertile ground for future exploration. Given the rather complex relationship between the three priority categories (accept, constrain, and enhance) that can be applied to any set of project success criteria chosen by project or organization management, there is considerable room for exploring how IT identity affects attitudes towards success criteria and, therefore, the threat to those criteria from project risk.

Research into the IKEA effect suggests that individuals do not increase their valuation of a consumer good, even when they have worked on it, if construction is not finished. Evidence here seems to indicate that the IKEA effect has different implications for software project team members. This active valuation comes under the Behaviors category of constructs in the theoretical model for IT identity for development team members. Findings here show that the majority of participants value the product under development for its potential impact on stakeholders (as well as its current impact for products already released in some form) and find it to be a source of meaning in their lives. While this research made no attempt at formal valuations as with the IKEA effect experiments, evidence does suggest the potential for strong self-identification with an

incomplete product. There are many factors that might differentiate software from the items used in the IKEA effect experiments, but the scale of the scope, budget, and schedule of the activity and identity functions activated by the item are areas for future exploration of the interactions between making a thing and valuation of that thing.

6.1.6 *Other Areas of IT Identity Research*

This work is focused on one specific form of IT identity: self-identification by a technology project team member with the product under development. While the model produced in the SEM process exhibited more exploratory power than the indicators created for adoption and use of commercial technology, this report makes no claims about the utility of these new indicators for other forms of IT identity. During later stages of measurement model development, however, consideration was given to creating indicators that would have utility for other forms of IT identity with minimal alteration. It is possible that indicators based on identity functions may outperform current IT identity indicators for consumer goods as well, so major area of future research is the utility of identity function indicators for other forms of IT identity.

6.2 Implications for Practice

This work is intended to inform improvements in IT project management, specifically in risk management for IT projects. It achieves this in several ways. First, it provides evidence that worker identities should be considered during risk management processes in a fashion previously reserved for worker skill sets. Second, it suggests human resources (HR) activities which can help minimize project risk. Finally, it provides possible avenues to help other stakeholders achieve better results with project team members.

While some types of worker identities have been considered in the past, studies have lacked a formal identity theory lens and have never involved material identities related to the product being developed. While project risk literature tends to view workers as collections of skills, the exploratory findings here show a direction for considering the identities of an individual and the standards of those identities when performing risk analysis, as skills have been used in the past. While the current model shows a weak but relevant effect of IT identity on iron triangle criteria attitudes, future work holds the promise for both better indicators for IT identity and more specific project behavior outcomes.

As with skill sets, mitigating risks related to IT identity involves either finding staff that minimize risk or organizational programs intended to create and nurture beneficial identities and identity standards, which are often the domain of HR management departments. Results of the exploratory SEM suggest that strength of IT identity with the product under development is positively correlated to attitudes that view schedule and budget as important. This means that strength of IT identity with a product may help indicate a quality of fit between an individual and organizational cultures that also prioritize schedule and budget on projects. The SEM suggests that future self-identification with the product might be predicted by a set of six questions focusing on the effectiveness and personal history functions, aiding in human resources decisions regarding team composition. Since the new theoretical model for IT identity and development team members (Figure 3.5) involves feedback loops related to project-based behaviors, interactions with team members provide a means of changing experiences and product characteristics in a manner that enhances worker self-identification with the product. Identity function indicators also offer an avenue to track changes to workers' IT identities longitudinally, as the project progresses.

Awareness of IT workers' identities can benefit more than just the immediate team and HR. For stakeholders, understanding who project team members are when they are working on shared projects can help achieve better results. While stakeholders may not control who is building the IT in which they are invested, their own behaviors can impact the identities they interact with, situationally. The same general feedback loops available to HR staff are also available in some form to other stakeholders, and provide a means for improving outcomes for their stakeholder group.

There are also potential negative implications. As shown, self-identification with the product can involve imbuing it with a great deal of personal meaning, and organizations often expect additional labor from workers without impact to schedule, budget, or scope. Ideally, the findings here will, eventually, provide a way to help people find greater fulfillment in their jobs without providing a path for exploitation of their self-identification with their work products.

6.3 Additional Limitations and Future Work

While the sample size for the SEM portion of this work was adequate overall, the degrees of freedom present in the emerging model prevented the use of multi-group analysis as grouping by characteristic produced groups too small to allow such analysis. As mentioned above, this

prevented inter-group comparisons, such as comparison by product type, development method, ownership, and other characteristics of the participants, their products, and their organizations. This shortcoming was particularly unfortunate for product type, where it was hoped that the data would allow comparisons between more utilitarian products and more hedonic products. A larger sample with more precise recruitment for these characteristics is indicated, but such a recruitment process would likely be expensive due to the relative expense of recruiting software professionals and the specificity of those other characteristics.

The research design was limited by the pandemic. Originally, the pre-pandemic design called for on-site case studies of development project teams with analysis of interviews and collected artifacts, but this was unacceptable due to COVID-19. Site visits would have afforded the opportunity for artifact collection and observation of the physical space in which the project team members functioned. These practices would have given insight into the ways in which these tech workers represented themselves—showed their identities—in their work environments. Instead of these practices, the qualitative portion of this research was performed on anonymous open-ended survey questions. This precludes the ability to follow up on answers for clarification and to explore emerging topics. It is certainly true that some portion of tech work was always remote, but the pandemic-mandated shift to work at home also changed the importance of office-based observations, at least during the time of this research. While the qualitative responses that were gathered did provide insights, the richness of the data was most certainly limited by this change. In the future, interviews should provide additional depth of analysis not possible in this work, and analysis of the differences between on-site and remote workers and their identities should provide insights for both theory and practice. Theoretically, we may find that the remote/on-site work status may impact the strength of IT identities, and practically we may be able to suggest different organizational praxis for building favorable identities on this basis.

The chosen problem domain for this research was IT project risk management, a sub-domain of the larger area of IT development. The research design intentionally include a variety of project team members, including participants of any job role associated with any class of IT development projects. A separate appeal was made to game development professionals, a category that more often includes art, sound design, narrative development, and level design than other forms of IT development. Essentially, a wide net was cast for participants. This combination—a project risk management focus on a wide spectrum of project workers—had inherent limitations.

The design could have been altered or expanded to include other sub-domains of IT development. One such sub-domain was mentioned above: remote work. Another option would be a specific investigation of software engineers, embracing literature for that profession rather than project risk management, or in conjunction with project risk management. While less generalizable to software development, a more uniform set of participants (in terms of skills and roles) may have permitted a clearer analysis of IT identity by limiting the broader set of identities involved.

6.4 CONCLUSION

As IT project management sources continue to report high failure rates, new approaches to managing project risk become more crucial. This study examined the ways in which worker self-identification with the deliverables of an IT project affects their attitudes and behaviors—specifically regarding standard project success criteria—with the intent of informing new risk management practices focused on each worker's identification with the technology they are building. A mix of methods were used to create and evaluate new theoretical and measurement models for self-identification with IT specifically for tech workers and their creations.

The results of the work show that a measurement model including indicators for identity functions better explains this phenomenon than existing IT identity measurement models focused on adoption and use of technology. SEM also indicates that a combination of identity measures—one focused on a specific technology and another on IT generally—perform better as a measure of self-identification with a technology than the specific measures alone.

Evidence from qualitative analysis shows that the measurement model which emerged through exploratory SEM has potential areas for improvement. Meaning-making emerged as an identity function despite its exclusion from the set of identity functions in the literature, which both expands our understanding of material identities and offers a direction for new IT identity indicators. Other specific versions of identity functions also emerged to provide direction for improved measures. For example, participants expressed effectiveness not only in terms of control of the product but in affecting the lives of stakeholders, pride emerged as a major emotional reaction to the product, and new stakeholder groups emerged to inform the future direction chosen for social identities.

The use of attitudes towards iron triangle criteria as dependent variables produced mixed results. SEM shows a statistically significant, positive relationship between a tech worker's self-

identification with the product they are building and the importance they give to schedule and budget, but no relationship with attitudes towards scope. This is surprising, since scope would seem to be the most obvious representation of the technology with which the worker is self-identifying, and qualitative analysis shows considerable emphasis on scope by participants. It is possible that spec attitudes are strongly correlated with a higher-level identity among tech workers, hiding the effect for IT identities. Analysis of responses to the critical incident question series provide new options for specific behaviors which may perform better than attitudes towards the iron triangle criteria.

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APPENDIX A: ADDITIONAL TABLES

Table A.1. Sample Characteristics

Variable	Value	f	%
Age	18-19	1	0.7
	20-29	28	19.7
	30-39	58	40.8
	40-49	38	26.8
	50-59	14	9.9
	60-69	2	1.4
	70-79	1	0.7
Gender	F	46	32.4
	M	90	63.4
	X	6	4.2
Employment Type	Employee	106	74.6
	Contractor	30	21.1
	Other	6	4.2
Software Type	Inernal	48	33.8
	B2B	39	27.5
	B2C Productivity	27	19.0
	B2C Social Media	6	4.2
	B2C Entertainment	17	12.0
	Other	5	3.5
Development Method	Agile	87	61.3
	Waterfall	47	33.1
	Other	8	5.6
Phase	Defining	26	18.3
	Planning	26	18.3
	Executing	72	50.7
	Closing	7	4.9
	Other	11	7.7
Ownership	Proprietary	96	65.3
	FLOSS	47	32.0
	Other	4	2.7
Education	Secondary School	10	7.0
	Some College	21	14.8
	College Degree	60	42.3
	Some Grad School	3	2.1
	Grad School Degree	48	33.8

Table A.2. Team and Organization Size

People…	… on Team		…in Org	
	f	%	f	%
1-4	26	18.3%	6	4.2%
5-9	25	17.6%	13	9.2%
10-19	30	21.1%	8	5.6%
20-49	26	18.3%	9	6.3%
50-99	13	9.2%	19	13.4%
100-249	7	4.9%	25	17.6%
250-499	6	4.2%	18	12.7%
500-999	4	2.8%	19	13.4%
1000 or more	5	3.5%	25	17.6%

Table A.3. Time with Team and Organization

Time…	…with Team		…with Org.	
	f	%	f	%
Less than 1 month	3	2.1%	5	3.5
Less than 3 months	3	2.1%	11	7.7
Less than 6 months	6	4.2%	17	12.0
Less than 1 year	9	6.3%	28	19.7
Less than 2 years	23	16.2%	30	21.1
Less than 3 years	22	15.5%	16	11.3
Less than 5 years	27	19.0%	9	6.3
Less than 10 years	29	20.4%	13	9.2
More than 10 years	20	14.1%	13	9.2

Table A.4. Triangle Attitude Responses

		Product Budget Prioritization						Product Scope Prioritization						Product Schedule Prioritization					
Software Type	**#**	**Higher**			**Lower**		**Same**	**Higher**			**Lower**		**Same**	**Higher**			**Lower**		**Same**
		f		μ	f	%	f	%	Σ	μ	f	%	f	%	Σ	μ	f	%	f	%
Internal	53	14	26.4	2.14	13	24.5	26	49.1	14	26.4	27	1.93	18	34.0	21	39.6	18	34.0	40	2.22	14	26.4	21	39.6
B2B	45	17	37.8	2.35	13	28.9	15	33.3	12	26.7	27	2.25	16	1.60	23	51.1	12	26.7	31	2.58	11	24.4	22	48.9
B2C Productivity	30	7	23.3	1.57	9	30.0	14	46.7	5	16.7	5	1.00	8	2.00	21	70.0	7	23.3	12	1.71	4	13.3	19	63.3
B2C Social Media	6	2	33.3	1.57	3	50.0	1	16.7	1	16.7	1	1.00	2	2.00	4	66.7	4	66.7	6	1.50	0	0.0	2	33.3
B2C Entertainment	18	7	38.9	1.00	4	22.2	7	38.9	4	22.2	4	2.00	4	22.2	10	55.6	5	27.8	10	2.00	3	16.7	10	55.6
Other	85	20	23.5	1.57	21	24.7	44	51.8	31	36.5	20	2.25	4	1.00	34	40.0	30	35.3	10	2.00	17	20.0	38	44.7
Total (w/o Other)	152	47	30.9	1.57	42	27.6	63	41.4	36	23.7	37	1.68	42	2.10	79	52.0	46	30.3	51	1.70	32	21.1	74	48.7
Total (w/ Other)	237	67	28.3	2.25	63	26.6	107	45.1	67	28.3	57	1.92	62	1.68	113	47.7	76	32.1	99	2.15	49	20.7	112	47.3
																			150	1.97	78	1.59		
Software Type		**Σ**	**μ**	**Σ**	**μ**			**Σ**	**μ**	**Σ**	**μ**								**Σ**	**μ**	**Σ**	**μ**		
Internal		30	2.14	24	1.85			27	1.93	32	1.78								40	2.22	21	1.50		
B2B		40	2.35	16	1.23			27	2.25	16	1.60								31	2.58	20	1.82		
B2C Productivity		11	1.57	15	1.67			5	1.00	8	2.00								12	1.71	4	1.00		
B2C Social Media		2	1.00	3	1.00			1	1.00	2	2.00								6	1.50	0	–		
B2C Entertainment		11	1.57	12	3.00			9	2.25	4	1.00								10	2.00	5	1.67		
Other		45	2.25	26	1.24			52	1.68	42	2.10								51	1.70	28	1.65		
Total (w/o Other)		94	2.00	70	1.67			69	1.92	62	1.68								99	2.15	50	1.56		
Total (w/ Other)		139	2.07	96	1.52			121	1.81	104	1.82								150	1.97	78	1.59		

APPENDIX B: DETAILED DESCRIPTION OF PLS-SEM PROCESS

This appendix offers additional detail regarding the exploratory process used in SmartPLS to create the new IT identity measurement model for tech professionals using indicators based on the identity-related functions of material goods.

B.1. IDENTITY FUNCTION MEASUREMENT MODEL CREATION

The creation of the identity function measurement model was performed with a separate group of participants than that for the final evaluation of the model.

SEM methods were combined with the intent of building a set of valid indicators for the set of latent variables represented by the identity-related functions of materials goods. Original intent had been to use analysis of qualitative interviews to produce a set of candidate indicators that can be applied to software developers and the products (commercial or otherwise) their teams create. Given that the pandemic had limited options for in-person, in-office interviews as intended, candidate variables were instead created based on review of relevant literature. **Stage 1** was the creation of these original candidate indicators.

With a set of candidate indicators constructed, **Stage 2** involved testing each measure's face validity by asking participants to perform a card sort of the proposed indicators into categories representing the identity-related functions of material goods. This stage allowed an initial evaluation of the indicators without an outlay of funds. Participants were recruited through a private PhD student message board. No monetary compensation was provided.

The sort was preceded by the following explanation and definitions, written for individuals who were not familiar with identity theory:

> The following table contains definitions of the identity functions for you to use in your sort. There is a "NA" column if there is no good option, so please evaluate every statement.

- Effectiveness (EFF): "The thing allows me a sense of control and to show competence."
- Emotional Regulation (EMR): "The thing is a means to generate, express, or regulate emotions (self-esteem, belongingness, continuity/stability)."

- Actual Identity (AID): “The thing represents who I am right now (my qualities and values, differentiating me from others).”
- Ideal Identity (IID): “The thing represents who I want to be (the qualities, values, and goals to which I aspire).”
- Personal History (PRH): “The thing provides a sense of continuity with my personal history and how I became the person I am today.”
- Symbolic Interrelatedness (SIR): “The thing represents a link to an individual (a friend, a family member, a colleague).”
- Social Identity (SID): “The thing represents a link to (or membership in) a group or subculture.”
- Not Applicable (NA): “There is no good relationship between a material identity function and this statement.”

Participants were encouraged to speak aloud while sorting each candidate measure into an identity function “bucket”. A sample of the card sort interface is provided in Figure B.1.

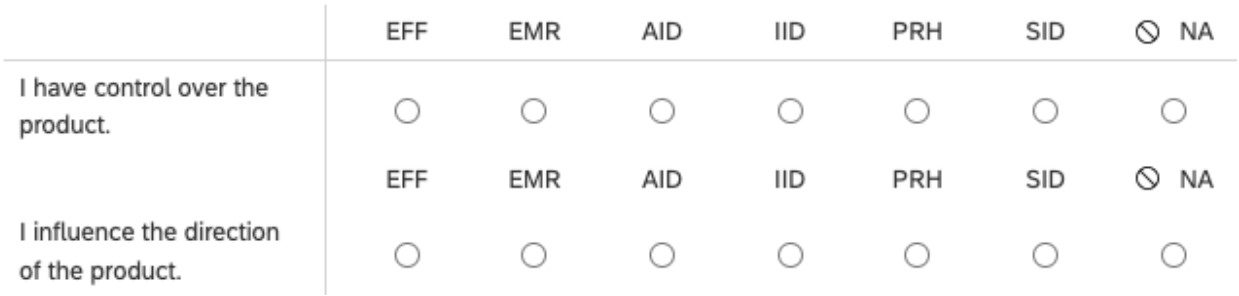


Figure B.1. Sample from the Qualtrics Card Sort

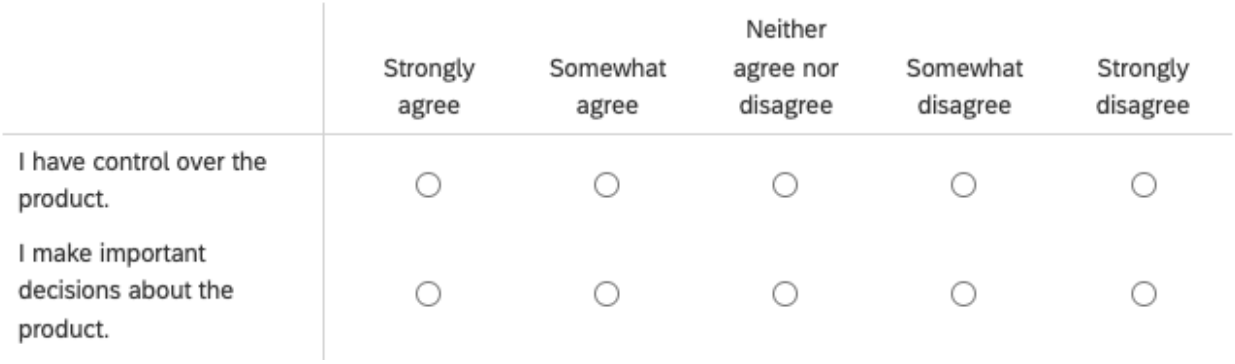
Any item which was sorted in a manner other than intended by more than one participant was rejected or re-written. At the end of Stage 2, the majority of indicators were rejected or re-written based on feedback. At this point, Symbolic Interrelatedness was dropped from the model. Symbolic Interrelatedness (SIR) is theorized as “relationships with specific others” and there are too many “specific others” involved in software development (even when abstracted to the level of product team or organizational roles) to include them all, and no single “specific other” emerged as a theoretical best candidate for which the function might be measured. Further research into SIR with other individuals is now “future work.”

Similar consideration was given to removing Social Identity (SID), which could involve any number of groups of which a software professional might consider themselves a member, including the product team and the host organization. However, it is theorized that a sense of

membership in the target user group for the product under development will elevate a worker's concern for the product's scope. All SID candidate indicators focus on the target user group. Analysis of open-ended questions in the final survey (below) shed additional light on the SID function with other groups as it relates to this work.

Having re-written many of the candidate indicators, the card sort exercise was conducted again as **Stage 3**. Descriptions of identity functions were slightly modified to clarify intent. Again candidate indicators were rejected or re-written based on feedback. At this point, the results from Stage 3 were deemed adequate to move on to a pilot study.

Stage 4 was a pilot study using Prolific participants, also conducted through a Qualtrics survey. Twenty-six (26) candidate indicators that passed Stage 3 were presented in matrix format with answers on a 5-point Likert scale from Strongly Agree to Strongly Disagree. Prolific participants were instructed: "For each of the statements below, 'the product' is the software your development team is currently making. Please read each carefully before responding." Two hundred twelve (212) responses were recorded. Guidelines from Malhotra & Grover (1998) indicate that only 130 responses were required to show adequate power for analysis. A sample of the card sort interface is provided in Figure B.2.



	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
I have control over the product.	○	○	○	○	○
I make important decisions about the product.	○	○	○	○	○

Figure B.2. Sample from the Qualtrics Pilot

The results of prior stages, four potential measures were tested for each remaining function.

- EFF1: I am confident that I make good decisions about the product.
- EFF2: I have control over the product.
- EFF3: The product lets me demonstrate competence in my profession.
- EFF4: I influence the direction of the product.
- EMR1: I feel happy when I think of the product.
- EMR2: I feel a sense of pride when I think of the product.

- EMR3: My association with the product gives me a feeling of stability.
- EMR4: My association with the product boosts my self-esteem.
- AID1: The product is an important part of who I am right now.
- AID2: My personal values are represented in the product.
- AID3: I see part of myself in the product.
- AID4: When I meet someone new, telling them about the product helps them understand who I am.
- IID1: I have a strong sense of how the product will help me achieve future career goals.
- IID2: I am growing into a better version of me as I work on the product.
- IID3: I want to make sure "future me" is happy with the completed product.
- IID4: I feel the product will influence the future of the whole field.
- PRH1: The product is a natural extension of my professional work history.
- PRH2: The product reminds me of technologies that were important to me in the past.
- PRH3: I keep memorabilia regarding past products in my work space.
- PRH4: A much younger me would be excited to know I was working on the product today.
- SID1: I am glad to belong to the product's target user group.
- SID2: I feel strong ties with the product's target user group.
- SID3: l consider the product's target user group important.
- SID4: l identify with the product's target user group.

Using the FACTOR command in SPSS produced initial analysis on the full set of measures. KMO and Bartlett's Test of Sphericity scores were better than required, so analysis continued. The results of analysis of Stage 4 data brought a strong theoretical re-alignment to these candidate indicators.

Table B.1 shows the pattern matrix table the FACTOR command when instructed to determine factors with eigenvalues greater than 1 on the results of Stage 3. EFF was splitting into two groups: EFF1/3 and EFF2/4. This is a split anong theoretical lines, as Dittmar (2021) indicates that the "effectiveness function closely resembles the self-efficacy identity motive, where individuals strive to feel competent and capable of influencing their environment" and also that "the psychological significance of possessions is seen as residing mainly in the control they afford their owner over the physical and social environment, and they are closely linked to identity for

precisely that reason. EFF1 and EFF3 are indicators for feeling competent when working on the product. EFF2 and EFF4 are about control, by influencing the outcome of the product. This suggests that there may be two separate identity functions in operation here, grouped together as effectiveness by Dittmar: competence (performing well) and control (influencing outcomes). The decision was made to introduce additional EFF candidate indicators pertaining to each for the next stage.

Table B.1. Pattern Matrix for Stage 3

	Factor			
	1	2	3	4
AID1	0.782			
AID2	0.764			
IID4	0.733			
AID4	0.650			
PRH	0.583			
AID3	0.464			
IID2	0.422	0.399		
IID1	0.415			
PRH2	0.334			
PRH1				
EMR2		0.789		
EMR4		0.786		
EFF3		0.699		
PRH4		0.661		
EMR1		0.625		
IID3		0.592		
SID3		0.510		
EFF1		0.459	0.301	
EMR3		0.391		
EFF4			0.811	
EFF2			0.802	
SID4				1.093
SID2	0.395			0.448
SID1				0.385

With ERM, ERM3 failed to factor with the others. Indicators for happiness, pride, and self-esteem correlated well, but the indicator for stability weakly associated with both ERM and a factor comprised mostly of AID indicators. ERM3 was removed and new ERM candidate indicators were

drafted, including two taken from consumer research. Dittmar (2008) notes that "emotional buying motives form a coherent, internally consistent dimension separate from other types of buying motives, reflecting concerns such as 'I get a real buzz from buying things' or 'I often buy things because it puts me in a better mood' (p. 64).

With AID, AID3 failed to factor with the others and was removed. This difference also has a theoretical justification: AID3 asks if the participant sees themselves as part of the product, where theory suggests they should see the product as part of themselves. New candidate indicators were written to better reflect the direction of the relationship.

IID2 was not grouping with the others and was removed. IID3 used an emotional term ("feel") which is why it is believed that it loaded with EMR indicators. While Dittmar (2021) uses "feel" in her description if the ideal identity function, the meaning in IID3 was intended for the "intuitive" meaning of "feel" and not the emotional meaning. Theory suggests "people make use of material possessions, among other strategies, to compensate for perceived inadequacies in their self-concept" (Dittmar, 2007, p. 35 paraphrasing Wicklund & Gollwitzer, 1982), and that "people pursue material symbols in order to reduce discrepancies between their actual and ideal self, which raises the question of whether material goods are a beneficial strategy for dealing with identity deficits" (Dittmar, 2011, p. 31). New indicators were considered that dealt with perceptions of inadequacies, but were eventually rejected. It was considered potentially more effective to create indicators about self-improvement instead. For example, "the product helps me compensate for my inadequacies" seems to resonate poorly compared to "the product lets me improve myself" while conveying approximately the same sentiment.

PRH performed poorly overall and was considered for removal. Eventually it was re-written and retained. PRH1 seemed to directly reflect theory since it's about a symbolic record of personal history, but was simplified and focused in re-write. The wording of PRH2 was overly complicated. The original idea was to tie history to non-work tech, but that was theoretically misguided since the indicators should focus on the current product and not other material goods. Similarly, PRH3 mentioned *other* projects (not *this* project). It also potentially confused material identification with the product and material identification with other materials (memorabilia). PRH4 was overly complicated, with the intent being to find if the current product induced feelings of nostalgia for past products, showing a personal historic link. PRH indicators were heavily edited, simplified, and re-focused on the current product.

SID indicators were originally based on Brown et al. (1986) which refers to Tajfel and Turner (1979) among others to suggest three categories of indicators for self-identification with a group: “awareness of group membership (which contributes to self-definition), evaluation (which relates to self-esteem) and affect” (p. 275) While Brown et al. includes reversed indicators, it was decided to avoid those during measurement model construction. Stage 4 used one of each, with a duplicate affect. While SID1, SID2, and SID4 created a factor, SID3—the lone “evaluation” item—loaded with other factors and was rejected. Other edits were made to remove possible EMR correlations (e.g., removing “glad” from an indicator).

The end of Stage 4 included a re-written, larger set of candidate indicators with better adherence to theory and less potentially emotion-based language outside of EMR. These indicators were taken through **Stage 5**, a third PhD card sort, and problematic candidates again removed. **Stage 6** was an additional round of pilot study using the same candidate pool of software professionals but with a new set of updated candidate indicators from Stage 5. This second pilot included 33 candidate indicators across the six identity functions. One hundred seventy-two (172) responses were recorded. Guidelines from Malhotra & Grover (1998) indicate that only 165 responses were required to show adequate power for analysis. Candidate measures were re-numbered, so candidate measures from Stage 4 cannot be assumed to have the same variable name as candidate measures from Stage 6.

During Stage 6, iterative use of RELIABILITY and FACTOR commands in SPSS narrowed the pool of candidate measures to 18. At this point, all RELIABILITY tests were producing results well in excess of the chosen 0.700 threshold for coefficient alpha (see Table B.2).

Table B.2. Coefficient Alpha of Identity Function Constructs

Identity Function	Coefficient Alpha
EFF	0.831
EMR	0.869
IID	0.891
IID	0.828
PRH	0.754
SID	0.901

The FACTOR command produced a Bartlet’s Test of Sphericity result with a significance of <.001, indicating that the data were suitable for factor analysis. Further use of the FACTOR

command found that candidate indicators were adequately identified for factors corresponding to the EFF, PRH, and SID latent variables (see Table B.3). While candidate indicators for EMR, AID, and IID were clumping together, FACTOR commands run while opting to produce the best three factors from that clump produced a set that sorted as intended (see Table B.4).

Table B.3. Pattern Matrix for Stage 6

	Factor			
	1	**2**	**3**	**4**
IID4	0.869			
IID5	0.818			
EMR6	0.811			
EMR4	0.766			
EMR1	0.761			
AID3	0.661			
IID3	0.643			
AID1	0.641			
AID7	0.611			
SID1		0.976		
SID3		0.792		
SID4		0.774		
EFF2			0.887	
EFF1			0.804	
EFF3			0.677	
PRH1				0.862
PRH4				0.646
PRH3				0.572

At this point, the measurement model was considered strong enough to include within the full survey instrument. The final candidate indicators were worded as follows:

- **Effectiveness**
    - EFF1: I have control over the product.
    - EFF2: I make important decisions about the product.
    - EFF3: I make good decisions about the product.
- **Emotional Regulation**
    - EMR1: I feel happy when I think of the product.

- EMR4: Thinking about the product improves my mood.
- EMR6: I find working on the product emotionally rewarding.

Table B.4. Pattern Matrix for Stage 6 “Clump”

	Factor		
	1	**2**	**3**
AID4	0.906		
AID3	0.637		
AID1	0.620		
AID7	0.591		
EMR4		0.903	
EMR1		0.821	
EMR6		0.569	
IID3			0.815
IID5			0.606
IID4			0.415

- **Actual Identity**
  - AID1: The product is an important part of who I am right now.
  - AID3: When I meet someone new, telling them about the product helps them understand who I am.
  - AID4: The product is part of me.
  - AID7: The product expresses something about who I am.
- **Ideal Identity**
  - IID3: The product fits who I want to be
  - IID4: The product brings me closer to the person I want to be.
  - IID5: The product brings me closer to my ideal self.
- **Personal History**
  - PRH1: The product reminds me of technologies that were important to me in the past.

  - PRH3: The product reminds me of my past successes.
  - PRH4: The product reminds me of tech from my past.
- **Social Identity**
  - SID1: I belong to the product's target user group.
  - SID3: I identify with the product's target user group.
  - SID4: I see myself as belonging to the product's target user group.

B.2. PLS-SEM Analysis of Identity Function Measurement Model

Data gathering for the full survey took place as described in Recruitment and Data Gathering, above. For this section, evaluation of structural models was performed using SmartPLS (Ringle et al., 2015). When the SmartPLS PLS Algorithm function was run, the "Path" weighting scheme was used. When the Bootstrapping function was run, the following settings were used:

- Subsamples: 10000
- Amount of Results: Complete Bootstrapping
- Confidence Interval Method: Bias-Corrected and Accelerated (BCa) Bootstrap
- Test Type: One-Tailed
- Significance Level 0.05

In exploring the use of identity functions as indicators of a software development professional's self-identification with the technology under development, the first obvious question regards the utility, composition, and structure of identity function indicators as a measure of self-identification. To be clear, it was never theorized that the full set of identity functions would operate as a suitable construct for self-identification with technology. Rather, this section of the research has always been intended to identify those identity functions (if any) which are activated when self-identification is present.

Model 1 (see Figure B.3) was intended to test the candidate indicators identified in Phase 6 of measurement model creation with data acquired through the Qualtrics survey. In Model 1, the identity function-based model of self-identification with the product under development (DI) was modeled as a second-order construct comprised of latent variables representing each identity function.

Effectiveness (EFF), Emotional Regulation (EMR), Actual Identity (AID), Ideal Identity (AID), Personal History (PRH), and Social Identity (SID). Figure B.3 shows a plus sign (+) inside

the DI latent variable which tells observers that all its indicators have been hidden from the diagram; they are the same set of indicators included on the left for each of the latent variables representing identity functions.

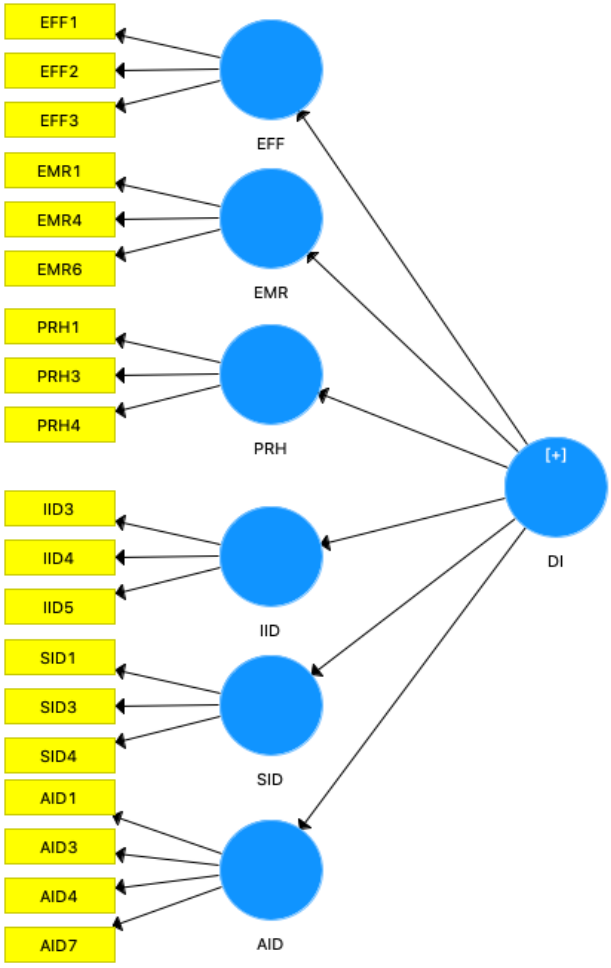


Figure B.3. Model 1

Checks for construct validity and reliability (Table B.5) show that each identity function latent variable exceeds reliability thresholds for composite reliability and AVE.

Table B.5. Model 1 Validity and Reliability

	Composite Reliability	**Average Variance Extracted (AVE)**
AID	0.904	0.702
DI	0.951	0.510
EFF	0.835	0.628
EMR	0.890	0.729
IID	0.923	0.800
PRH	0.856	0.664

SID	0.920	0.793

Table B.6. Model 1 Outer Loadings

	AID	DI	EFF	EMR	IID	PRH	SID
AID1	0.819						
AID1		0.735					
AID3	0.846						
AID3		0.767					
AID4	0.854						
AID4		0.771					
AID7	0.831						
AID7		0.794					
EFF1			0.852				
EFF1		0.642					
EFF2			0.731				
EFF2		0.471					
EFF3			0.791				
EFF3		0.618					
EMR1				0.861			
EMR1		0.788					
EMR4				0.893			
EMR4		0.786					
EMR6				0.805			
EMR6		0.677					
IID3					0.892		
IID3		0.80					
IID4					0.903		
IID4		0.780					
IID5					0.888		
IID5		0.820					
PRH1						0.854	
PRH1		0.683					
PRH3						0.788	
PRH3		0.666					
PRH4						0.802	
PRH4		0.492					
SID1							0.889
SID1		0.695					
SID3							0.905
SID3		0.723					
SID4							0.877
SID4		0.733					

However, the outer loadings report (Table B.6) shows that all EFF and PRH indicators load poorly into DI. EMR6 and SID1 are also below the "good" threshold but well above the absolute minimum of 0.40.

This outcome is consistent with theory represented in Carter & Grover (2015) as well as the proposed model of IT identity for products under development found in Figure 3.5. Both include an entity for "Experience" which is an antecedent for IT identity. EFF can be seen as represented in concepts of self-efficacy and expertise represented in the two, respectively, and my proposed model explicitly includes Work History as a component of Experience.

The HTMT report (Table B.7) shows discriminant validity flaws in Model 1. The identity function latent variables are not sufficiently distinct from one another to justify their use in a second-order construct for DI. All indicators seem to be contributing to the same underlying DI construct, suggesting an underlying unidimensional construct.

Table B.7. Model 1 HTMT Report

	AID	**DI**	**EFF**	**EMR**	**IID**	**PRH**	**SID**
AID							
DI	1.008						
EFF	0.758	0.911					
EMR	0.905	0.999	0.800				
IID	0.977	0.971	0.683	0.925			
PRH	0.737	0.907	0.649	0.808	0.723		
SID	0.780	0.892	0.718	0.718	0.707	0.710	

Model 2 shows DI in a highly flattened model. Due to the high correlation among indicators, AID, EMR, IIR, and SID indicators were all modeled as direct indicators of DI, and EFF and PRH were modeled as antecedents to DI, as shown in Figure B.4. Note that the arrows specifying the relationships EFF->DI and PRH->DI are no longer reflective of DI, but formative of DI.

Model 2 functions much better than Model 1. The outer loadings report (Table B.8) shows small issues persist with the EMR6 and SID1 indicators, but both are well above the 0.40 absolute minimum for consideration and both construct reliability (Table B.9) and discriminant validity (Table B.10) are all above recommended levels, indicating that EMR6 and SID1 can and should be retained.

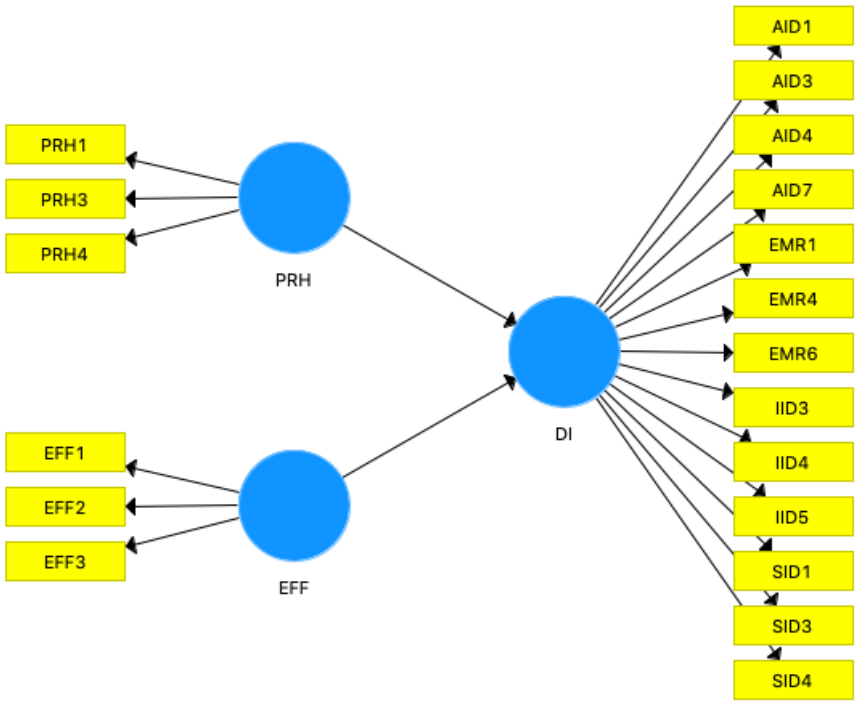


Figure B.4. Model 2

Table B.8. Model 2 Outer Loadings

	DI	EFF	PRH
AID1	0.744		
AID3	0.784		
AID4	0.795		
AID7	0.805		
EFF1		0.852	
EFF2		0.728	
EFF3		0.793	
EMR1	0.791		
EMR4	0.790		
EMR6	0.677		
IID3	0.823		
IID4	0.801		
IID5	0.833		
PRH1			0.855
PRH3			0.789
PRH4			0.800
SID1	0.699		
SID3	0.728		
SID4	0.742		

Table B.9. Model 2 Reliability and Validity

	Composite Reliability	Average Variance Extracted (AVE)
DI	0.950	0.595
EFF	0.834	0.628
PRH	0.855	0.664

Table B.10. Model 2 HTMT

	DI	EFF	PRH
DI			
EFF	0.793		
PRH	0.796	0.649	

With an acceptable, functional model for DI identified, attention can turn to modeling of the DV. **Model 3** represents the first attempt.

Lacking an existing measure for risk behavior for software projects, the questionnaire created for this study included two sets of three prompts intended to identify attitudes towards the iron triangle criteria: one set for software development in general and one for the specific product to which they currently contribute.

> "When you think of [***software development in general / your product***], how important do you feel each of the following is, where 1 is extremely important and 9 is not at all important?"

Prompts were provided for budget, scope, and schedule. While the original prompt stated that lower numbers were more important, the response values were flipped so that the results show positive correlations as importance increases, which is a more intuitive way to interpret the results in the SmartPLS reports.

Since DI is not theorized to have an impact on general iron triangle attitudes, that set of indicators was not included in this version of the model. This version includes an endogenous latent variable labeled PTA which is formed by the responses specific to attitudes regarding budget, scope, and schedule for their product. Figure B.5 shows additions made to Model 2 to create Model 3 while hiding the indicators for established portions of the model.

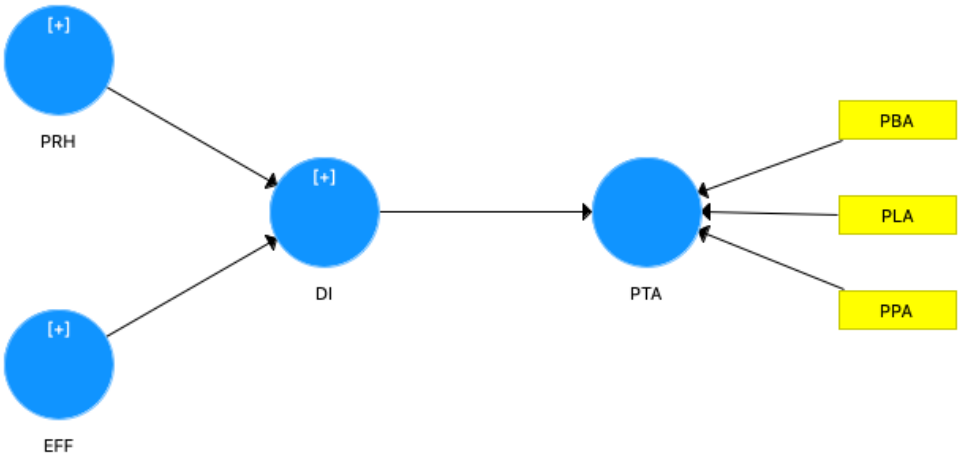


Figure B.5. Model 3

Reports indicate issues with Model 3, as PPA loads poorly and negatively against PBA and PLA. This issue is suspected to stem from fundamental differences between PPA and the other indicators. As will surface in qualitative analysis below, software projects often have a "time is money" mindset, and staff salaries are often the major expense in development projects. Schedule and budget are seen as expenses. It could be expected that PBA and PLA will highly correlate, particularly for software professionals. Scope, on the other hand, is not spent like time and money. Where enhancing project performance in terms of budget and schedule involve decreasing money and time spent, enhancing project performance in terms of scope is a matter of increasing the quality of the deliverables. It can be expected that PPA is inversely correlated with PBA and PLA. These expectations are evident in Table B.11 which contains outer loadings and weights for these three as indicators of a common latent variable for project-based iron triangle attitudes (PTA).

Table B.11. Model 3 Outer Loadings and Weights

	PTA	
	Loadings	**Weights**
PBA	0.819	0.649
PLA	0.778	0.900
PPA	0.326	-0.710

If PBA and PLA were combined in a single LV and PPA left on its own, and given that PBA and PLA are assumed to be correlated, their modeling would be in a common reflective LV,

not a formative LV. Since there is no solid theory that explains what LV they jointly represent, and since there are no other indicators available to test this unnamed potential LV, it was decided to pursue a model where PBA, PLA, and PPA are each single-indicator DVs. This is labeled **Model 4** and appears in Figure B.6.

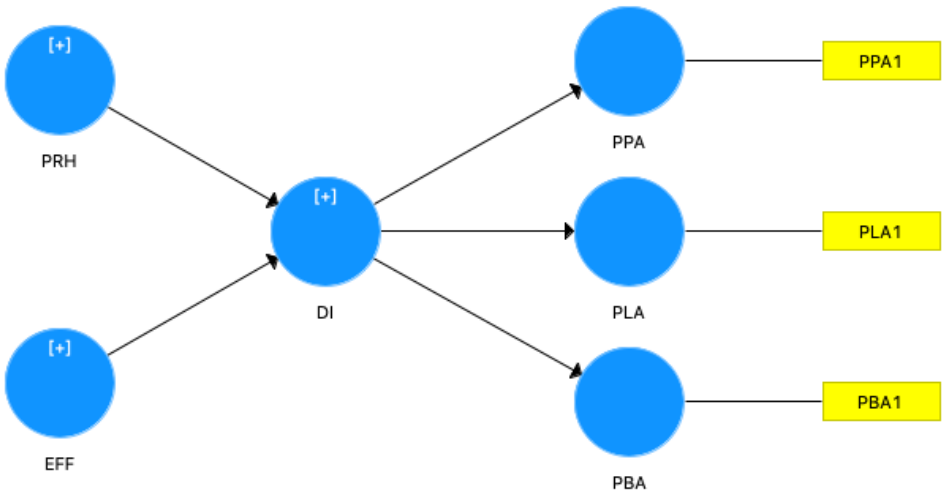


Figure B.6. Model 4

Running its Bootstraping function against Model 4, SmartPLS reports R^2 values and path coefficients for each endogenous variable (Table B.12). The R^2 statistic for each relationship between DI and a triangle attitude measure can be characterized as weak, but still having informational value (Hair et al. 2022).

Table B.12. Model 4 Path Coefficient and R^2

	Path Coefficient	**R^2**
DI->PBA	0.359	0.129
DI->PLA	0.342	0.117
DI->PPA	0.145	0.021

Model 5 builds on Model 4, integrating concepts regarding a general IT identity, labeled CGG. CGG is reflected in six indicators, two each regarding IT identity dimensions of emotional energy, relatedness, and dependence (DEPG1, DEPG2, RELG1, RELG2, DEPG1, DEPG2). CGG is theorized as moderating the effect of DI on each of the DVs. Figure B.7 illustrates these

relationships. The CGG construct is introduced and connected to each DV, and the green circles represent moderating effects of CGG on DI for each DV (labeled MOD-X, where X is the appropriate DV for each).

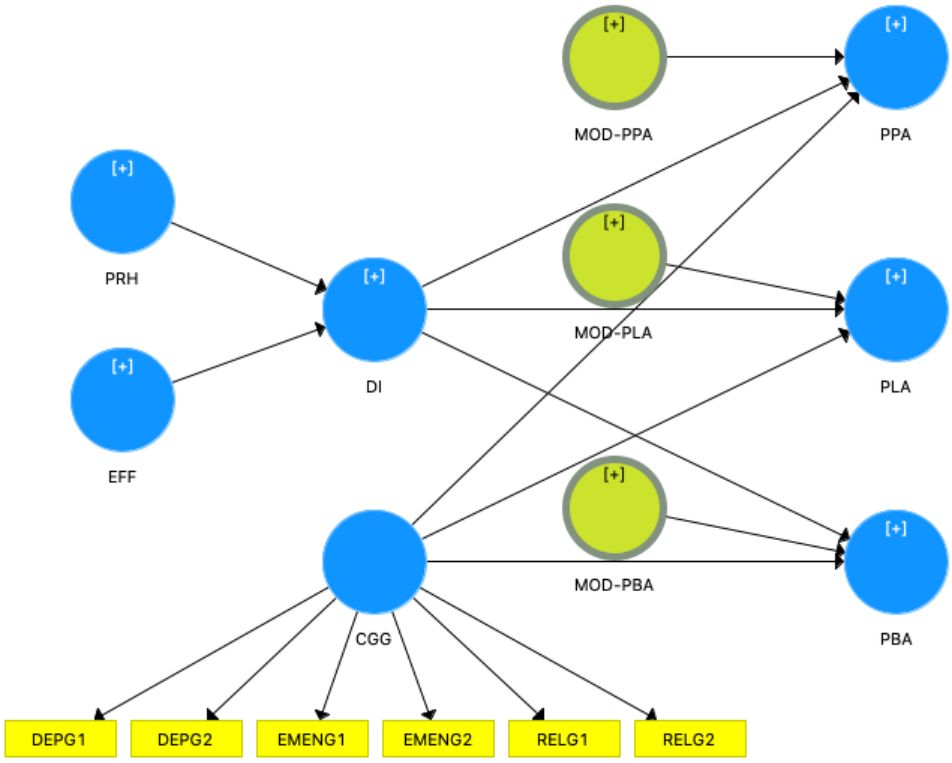


Figure B.7. Model 5

As a newly-introduced construct, the PLS Algorithm function allows quick evaluation of that portion of the updated model. The Outer Loadings report for the new construct show loadings under 0.70 for EMENG2 and RELG2 (Table B.13) but both the Construct Reliability and Validity report (Table B.14) and the Discriminant Validity report (Table B.15) show no problems with the construct. Since EMENG2 and RELG2 are both well above the 0.40 cutoff and part of a tested model for IT identity (Carter et al. 2020) they are retained.

With the CGG construct passing checks, attention can turn to its interaction with the rest of the model. The PLS Algorithm reports (Table B.16) indicate that all three moderating effects have insufficient AVE scores to remain in the model despite having adequate composite reliability scores.

TABLE B.13. Model 5 Outer Loadings

	CGG

DEPG1	0.724
DEPG2	0.763
EMENG1	0.731
EMENG2	0.623
RELG1	0.770
RELG2	0.664

Table B.14. Model 5 Construct Reliability and Validity

	Composite Reliability	**Average Variance Extracted (AVE)**
CGG	0.862	0.510
DI	0.950	0.595
EFF	0.835	0.628
PRH	0.856	0.664

Table B.15. Model 5 HTMT

	CGG	**DI**	**EFF**	**MOD-PBA**	**MOD-PLA**	**MOD-PPA**	**PBA**	**PLA**	**PPA**	**PRH**
CGG										
DI	0.533									
EFF	0.697	0.793								
MOD-PBA	0.181	0.064	0.169							
MOD-PLA	0.181	0.064	0.169	1.000						
MOD-PPA	0.181	0.064	0.169	1.000	1.000					
PBA	0.414	0.367	0.368	0.128	0.128	0.128				
PLA	0.383	0.348	0.316	0.055	0.055	0.055	0.630			
PPA	0.283	0.145	0.167	0.061	0.061	0.061	0.559	0.748		
PRH	0.553	0.796	0.649	0.029	0.029	0.029	0.256	0.362	0.104	

In order to test an alternative to the DI-focused model, **Model 6** (Figure B.8) was created by substituting a construct representing existing IT identity indicators, labeled CGP. Like CGG for a general IT identity, CGP is reflected in six indicators, two each regarding IT identity dimensions of emotional energy, relatedness, and dependence (DEPP1, DEPP2, RELP1, RELP2, DEPP1, DEPP2). Unlike CGP, which asks questions based on IT generally, CGP indicators were worded specific to the product under development. Specific wording can be found in the Appendix. For this text, moderators from Model 5 were left in place, updated to moderate the relationship between CGP and the DVs.

Table B.16. Model 5 Construct Reliability and Validity with Moderating Effects

	Composite Reliability	Average Variance Extracted (AVE)
CGG	0.862	0.510
DI	0.950	0.595
EFF	0.835	0.628
MOD-PBA	0.966	0.274
MOD-PLA	0.950	0.205
MOD-PPA	0.922	0.156
PBA	1.000	1.000
PLA	1.000	1.000
PPA	1.000	1.000
PRH	0.856	0.664

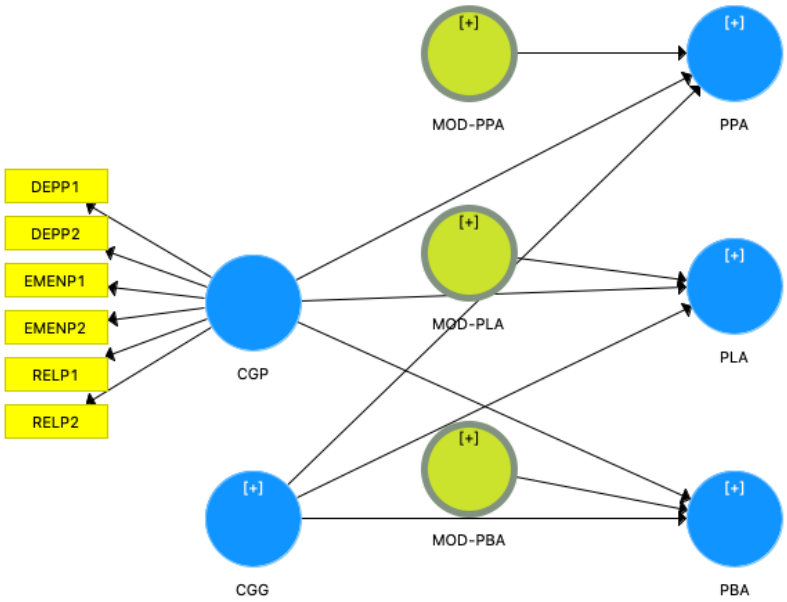


Figure B.8. Model 6

Results of the PLS Algorithm indicate that, like the CGG construct, the CGP construct has a slight deficiency regarding the EMENP2 measure, loading at 0.694. Aside from EMENP2, the CGP construct passes all tests for construct reliability and validity (Table B.17) as well as discriminant validity (Table B.18). As with Model 5, each test of CGG moderating CGP's relationship with the DVs fails AVE tests.

Table B.17. Model 6 Composite Reliability and AVE

	Composite Reliability	Average Variance Extracted (AVE)
CGG	0.862	0.510
CGP	0.901	0.603
MOD-PBA	0.917	0.254
MOD-PLA	0.918	0.253
MOD-PPA	0.912	0.240
PBA	1.000	1.000
PLA	1.000	1.000
PPA	1.000	1.000

Table B.18. Model 6 HTMT

	CGG	CGP	MOD-PBA	MOD-PLA	MOD-PPA	PBA	PLA	PPA
CGG								
CGP	0.732							
MOD-PBA	0.000	0.000						
MOD-PLA	0.000	0.000	1.088					
MOD-PPA	0.000	0.000	1.088	1.088				
PBA	0.414	0.371	0.222	0.222	0.222			
PLA	0.383	0.324	0.164	0.164	0.164	0.630		
PPA	0.283	0.155	0.141	0.141	0.141	0.559	0.748	

The moderating effects were removed from both Model 5 and Model 6, creating **Model 7** and **Model 8**, respectively (Figure B.9 and Figure B.10). The PLS Algorithm was run on Model 04 (DI without CGG), Model 7 (DI with CGG), and Model 08 (CGP with CGG), and the results were compared (Table B.19).

Among these three options, Model 7 has the highest explanatory power for all three DVs: For the relationship between identity and iron triangle criteria attitudes, Model 7—using indicators based on the identity-related functions of material goods—has the most explanatory power.

Bootstrapping was performed on Model 7 to determine the statistical significance of these effects (Table B.20). Each connection is statistically significant except DI->PPA, which again shows this model set's overall difficulty in modeling a relationship between IT identity and developer attitudes towards the scope of their project.

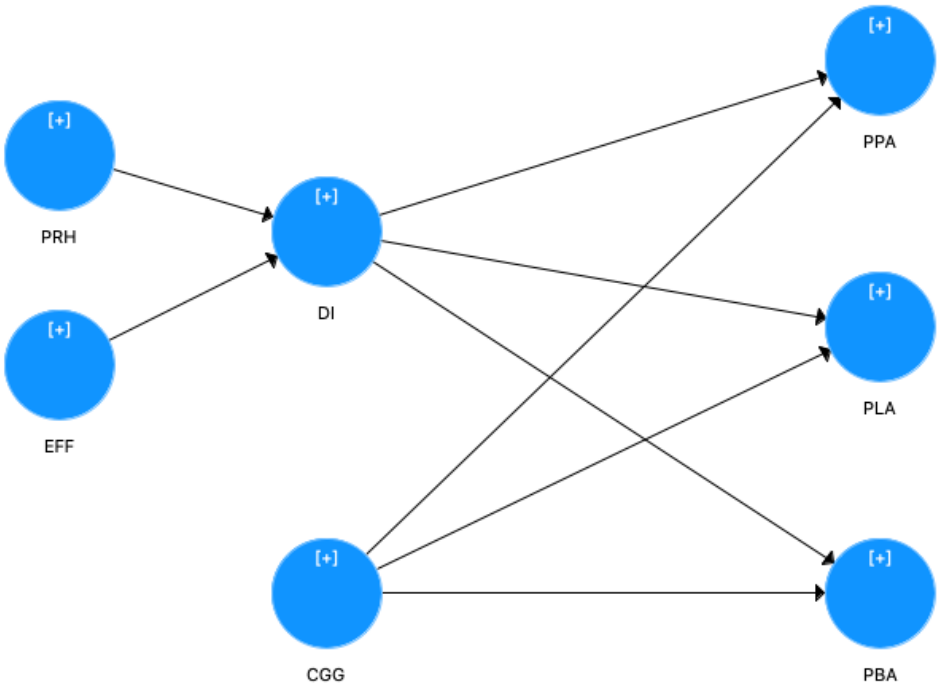


Figure B.9. Model 7

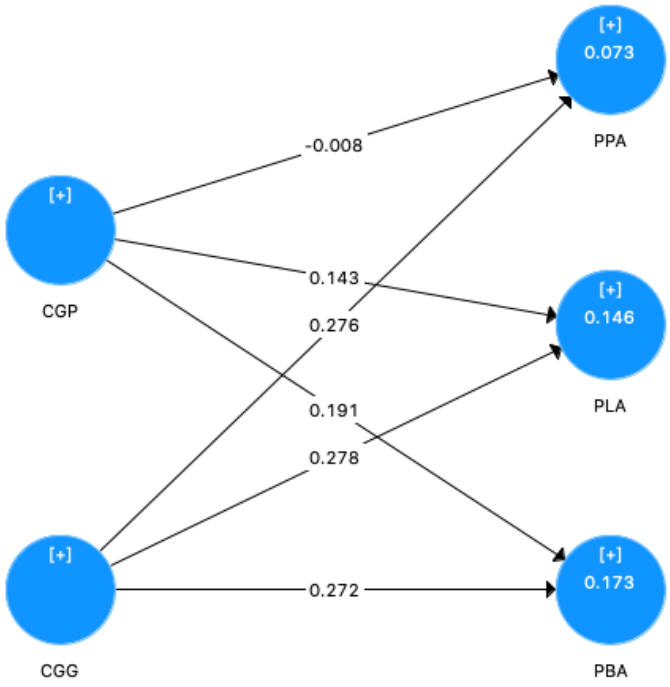


Figure B.10. Model 8

Table B.19. R^2 Comparison

	Model 4	Model 7	Model 8
PBA	0.129	0.194	0.173
PLA	0.117	0.173	0.146
PPA	0.021	0.074	0.073

Table B.20: Mean, STDEV, T-Values, P-Values for MODEL 7

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
CGG -> PBA	0.283	0.298	0.083	3.411	0.000
CGG -> PLA	0.265	0.281	0.091	2.924	0.002
CGG -> PPA	0.257	0.275	0.092	2.788	0.003
DI -> PBA	0.234	0.231	0.076	3.080	0.001
DI -> PLA	0.225	0.221	0.088	2.540	0.006
DI -> PPA	0.032	0.027	0.102	0.311	0.378
EFF -> DI	0.414	0.421	0.084	4.912	0.000
PRH -> DI	0.476	0.474	0.088	5.410	0.000

APPENDIX C: SURVEY INSTRUMENT

This appendix contains the text and structure of the survey instrument used for this research for all material following the informed consent page and screening questions.

Please tell us a bit about yourself, your team, and your organization.
When we ask about ***the product*** below, we are referring to the technology your team is developing.

Who are you in regards to the organization for which you are making the product?
"I am..."

- o An official employee of the organization that owns the technology I am building.
- o A contract employee for the organization that owns the technology I am building.
- o Something else (please explain) (5)

_____

What is your official job title?
"I am..."

_____

Sometimes job titles don't adequately express your function on a team or in an organization. Considering the work you do on a regular basis, what professional title would you give yourself?
"I am..."

_____

Which of the following best describes the product your team is developing?
"Our project team is making..."

- o Business software being developed by our organization for its own use (internal). (1)
- o Business software being developed by our organization for use at other organizations (business to business) (2)
- o Productivity software being developed for public consumption (business to consumer productivity) (3)
- o Social media software being developed for public consumption (business to consumer social media) (4)
- o Entertainment software being developed for public consumption (business to consumer entertainment) (5)
- o Other (please specify) (6) _____

Which of the following categories best describes the methodology used by your team to develop the product?

- o Agile (12)
- o Waterfall (14)
- o Other (please specify) (16) _____

Which of the following categories best describes the ownership of the technology your team is developing?

- o The product is a Free/Libre/Open Source Software project. (1)
- o The product is a proprietary software project. (2)

- o Other (please specify) (3) _____

Given the following list of phases, where would you say your team is in its project life cycle?

- o Defining (setting goals, defining a spec, assigning long-term responsibilities) (1)
- o Planning (making specific schedules and budgets, assigning resources, analyzing risk, forming teams) (2)
- o Executing (completing work, tracking progress, managing change) (3)
- o Closing (delivering the product, dissolving teams, documenting lessons learned) (4)
- o Other (please specify) (5) _____

How many people do you consider to be part of your **project team**?

- o 1-4
- o 5-9
- o 10-19
- o 20-49
- o 50-99
- o 100-249
- o 250-499
- o 500-999
- o 1000 or more

How many people do you consider to be part of your **whole organization**?

- o 1-4
- o 5-9
- o 10-19
- o 20-49
- o 50-99
- o 100-249
- o 250-499
- o 500-999
- o 1000 or more

How long have you worked on this **project team**?

- o Less than 1 month
- o Less than 3 months
- o Less than 6 months
- o Less than 1 year
- o Less than 2 years
- o Less than 3 years
- o Less than 5 years
- o Less than 10 years
- o More than 10 years

How long have you worked at this **organization**?

- o Less than 1 month
- o Less than 3 months
- o Less than 6 months
- o Less than 1 year
- o Less than 2 years

- o Less than 3 years
- o Less than 5 years
- o Less than 10 years
- o More than 10 years

Page Break

In this section, we ask you to consider your relationship with ***technology in general***, and then follow by asking you about your relationship with *the* ***product your team is developing***.

Thinking about myself in relation to *technology in general*....
I am (blank) technology. [Order of items randomized]

	Describes me extremely well	Describes me very well	Describes me moderately well	Describes me slightly well	Does not describe me
Connected with	o	o	o	o	o
Linked with	o	o	o	o	o
Energized by	o	o	o	o	o
Enthusiastic about	o	o	o	o	o
Depending on	o	o	o	o	o
Relying on	o	o	o	o	o
Taken over by	o	o	o	o	o
Opposed to	o	o	o	o	o
Drained by	o	o	o	o	o
Irritated by	o	o	o	o	o
Wanting to avoid	o	o	o	o	o
Threatened by	o	o	o	o	o

Page Break

Thinking about myself in relation to *the product my team is developing*....
I am (blank) the product. [Order of items randomized]

	Describes me extremely well	Describes me very well	Describes me moderately well	Describes me slightly well	Does not describe me
Connected with	o	o	o	o	o
Linked with	o	o	o	o	o
Energized by	o	o	o	o	o
Enthusiastic about	o	o	o	o	o

Depending on	o	o	o	o	o
Relying on	o	o	o	o	o
Taken over by	o	o	o	o	o
Opposed to	o	o	o	o	o
Drained by	o	o	o	o	o
Irritated by	o	o	o	o	o
Wanting to avoid	o	o	o	o	o
Threatened by	o	o	o	o	o

Page Break

Again, for each of the statements below, ***the product*** refers to the technology your team is developing. Please read each carefully before responding. [Order of items randomized]

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
I have control over the product.	o	o	o	o	o
I make important decisions about the product.	o	o	o	o	o
I make good decisions about the product.	o	o	o	o	o
I feel happy when I think of the product.	o	o	o	o	o
Thinking about the product improves my mood.	o	o	o	o	o
I find working on the product emotionally rewarding.	o	o	o	o	o
The product is an important part of who I am right now.	o	o	o	o	o
When I meet someone new, telling them about the product helps them understand who I am.	o	o	o	o	o
The product is part of me.	o	o	o	o	o
The product expresses something about who I am.	o	o	o	o	o

The product fits who I want to be.	o	o	o	o	o
The product brings me closer to the person I want to be.	o	o	o	o	o
The product brings me closer to my ideal self.	o	o	o	o	o
The product reminds me of technologies that were important to me in the past.	o	o	o	o	o
The product reminds me of my past successes.	o	o	o	o	o
The product reminds me of tech from my past.	o	o	o	o	o
I belong to the product's target user group.	o	o	o	o	o
I identify with the product's target user group.	o	o	o	o	o
I see myself as belonging to the product's target user group.	o	o	o	o	o
I am reading carefully. This is a standard survey attention test. Please respond with strongly agree.	o	o	o	o	o

Page Break

Project success is often evaluated in terms of **budget** (cost), **scope** (features), and **schedule** (time), and software project management is often an exercise in trying to balance these three constraints.

When you think of ***software development in general***, how important do you feel each of the following is, where 1 is extremely important and 9 is not at all important.

	Extremely important			Moderately Important				Not at all important
	1	2	3	4	5	6	7	8	9
Budget	[Slider Control]								
Scope	[Slider Control]								
Schedule	[Slider Control]								

When you think of ***your product***, how important do you feel each of the following is, where 1 is extremely important and 9 is not at all important.

	Extremely important			Moderately Important				Not at all important	
	1	2	3	4	5	6	7	8	9
Budget				[Slider Control]					
Scope				[Slider Control]					
Schedule				[Slider Control]					

Page Break

We are very close to the end of the survey. We have a set of short written questions followed by a couple of short demographic questions.

Please think of a time when the team had to make a decision that would impact the product's schedule, budget, or scope when answering the following questions.

Briefly describe the situation and decision.

_____
_____
_____
_____
_____

How did you personally decide which option was best (regardless of which path the team chose)?

_____
_____
_____
_____
_____

What were the pros (the factors in favor) you weighed in your decision?

_____
_____
_____
_____
_____

What were the cons (the factors against) you weighed in your decision?

_____
_____
_____
_____
_____

Now that we have asked you to consider your relationship to the product, we'd like you to tell us more about that relationship.
What does the product mean to you, personally?

_____

_____
_____
_____
_____

Page Break

This is the final section of the survey. We appreciate your responses so far. Our last few questions ask for some information about yourself. Please remember that this survey is anonymous. We are not using this information to identify you in any way. We use this information to be able to understand the types of people who have responded to our survey.

How would you describe your gender? "I am...."

_____

In what year were you born? (YYYY)

_____

What is the highest level of education that you have completed?

- o Secondary School (1)
- o Some College or University (2)
- o College or University Degree (3)
- o Some Graduate School (4)
- o Graduate School Degree (5)