# Advancing Software Product Management Education: Insights from an Industry Survey


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## Abstract

Software product managers have become critical to a software product's success. They act as a liaison among various stakeholders – software engineers, management, and customers – to ensure a product meets customer needs. Despite the role's rise in popularity, research and related educational materials are just emerging. In this paper, we aim to understand the educational needs of software product managers, and why embedding them in a software team is valuable. To do this, we collected survey responses from 59 software product managers and 63 software engineers, with responses from at least 24 companies, to identify the topics, skills, and abilities that software product managers find important for the role and the value they provide to software teams. Our results reveal that a software product manager's value stems from their ability to provide the team with direction and a plan, give context for decision-making, and effectively communicate across stakeholders. To support this, someone new to the role must have competencies in technical and non-technical areas. A software product manager must excel at interpersonal communication, understanding the technical atmosphere, and deriving product sense from a vision and strategy. This paper provides the groundwork for future software product management curricula by identifying 21 key competencies and 10 factors to describe the role's value in software teams.



## CCS Concepts

• **Software and its engineering → Software creation and management**; **Collaboration in software development**; • **Social and professional topics → Computing education**.

## Keywords

Software Product Management, Survey Methodology, Qualitative Analysis





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## 1 Introduction

A *PM* can represent many different roles across industries – *Project*, *Program*, or *Product Manager*. The literature suggests that *project* management is for projects that heavily rely on timelines and a specified budget, and *program* management is a longer-term version of project management [16]. *Product* management, by contrast, focuses on delivering value and is customer-driven, which lends to a much larger timeline [12]. In this paper, we specifically focus on the *software* product manager (SPM) role, which deals with *abstract* and invisible products [17].

To further differentiate the SPM role from traditional product management, in 2022, the International Software Product Management Association (ISPMA) developed the software product management body of knowledge (SPMBok). This prescriptive literature expands on the embedded nature of the role within a software team, their collaboration efforts with other stakeholders, and the challenges of software products.

From an educational perspective, product management is often paired with marketing [16] and taught through a business college. Thus, it can be challenging for computer science (CS) and software engineering (SE) students to gain exposure to the role. Furthermore, additional challenges attributed to intangible products (e.g., replication and distribution [17]) are outside the scope of current curricula, as they cater toward more tangible products. However, the need for related coursework is nascent. Based on LinkedIn profiles in the alumni network, approximately 1 in 24 graduates from the Department of Computer Science at North Carolina State University (NCSU) eventually become an SPM or similar. For undergraduate programs, out of the most recent ACM curricula–Computer Science Curricula 2023 (CS2023), Computing Curricula 2020 (CC2020), and Software Engineer Curriculum Guidelines 2014 (SE2014)–only one, CC2020, mentions that students must *"follow process and product management procedures,"* without any additional guidance [9, 18, 22]. We view this as a gap between what is

(1) **Role Identifier Question:** Within the software industry, are you in a more product-focused or engineering-focused role? [*Single-Response*]
  (a) Product-focused (e.g., software product manager, technical product manager, user experience) *[to Question 2]*
  (b) Engineering-focused (e.g., software engineer, engineering manager, data scientist, technical program manager) *[to Question 3]*
  (c) Neither / I'm not in the software industry *[Exit]*
**(2) SPM Education:** Suppose an educator is designing an undergraduate course to teach software product management to computer science majors. Based on your experience, what topics, skills, or abilities should be taught? Why is each important to your profession? *[up to 5 Free-Text] [to Question 3]*
**(3) SPM Value:** What is the most valuable thing a software product manager provides for software engineering teams? *[1 Free-Text] [Exit]*

**Figure 1: Survey Questions**

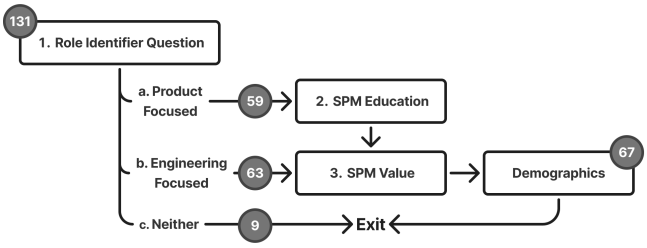


**Figure 2: Survey flow after informed consent. The circles show the number of respondents for each path.**

currently being taught and the educational needs of many of our graduates.

Students on this career path must understand the competencies required of SPMs. CC2020 defines *competency* as *"a combination of knowledge, technical skills, and human behavior within a computing context"* [9] where we adapted this list to correlate to topics, skills, and abilities, respectively. To better prepare students to become SPMs, we strive to pinpoint the professional competencies that are most important for the role, and develop a course that maps the competencies to student learning objectives (SLOs). To do this, we surveyed 63 software engineers (SWEs) and 59 SPMs representing at least 24 software companies. *This data provides the foundation for the key contribution of this work: 21 key competencies for SPMs, why they should be taught, and to what end, guided by the value of an SPM to the software team.*

We address the following research questions:

**RQ1** What topics, skills, or abilities do practicing software product managers think should be taught to future product managers enrolled in a computer science program?

**RQ2** What value do software product managers add to a team, according to software engineers and software product managers?

The rest of the paper is organized as follows: Section 2 describes the study. RQ1 is answered in Section 3, and RQ2 is answered in Section 4. We situate our results among prior research in Section 5. We describe our current undergraduate SPM course in Section 6. Threats to Validity are in Section 7 and are followed by the conclusion.

## 2 Research Method

The primary purpose of our study is to learn about industry practitioners' perspectives on software product management education and the value of the role. Our work is inspired by and directly compared to a rich sequence of related work, presented in detail in Section 5. Regarding the methodology, in 2014, when the role of a data scientist on a software team was relatively new, Zimmerman and Begel analyzed the most important questions software engineers want to ask a data scientist at Microsoft [1]. Later, in 2020, Huijgens et al. replicated this study within a financial tech company [15]. Pivoting from the data science focus, Denny et al. used this methodology to ask CS educators what questions CS education researchers should investigate [4] and *why* they wanted to know. We adapt this methodology with a focus on SPMs.

### 2.1 Survey Design

We sought responses from software industry practitioners where the survey, with questions shown in Figure 1, is available [8]. After receiving consent, Question 1, the only required question, asks participants to self-classify their professional position as product-focused (e.g., software product manager, technical product manager, user experience), engineering-focused (e.g., software engineer, engineering manager, data scientist, technical program manager), or neither. In this paper, we will refer to product-focused respondents as SPMs and engineering-focused respondents as SWEs. This distinction determines which questions are shown to the respondent; the three potential paths are depicted in Figure 2. The data was not analyzed if the respondent selected *Neither / I'm not in the software industry*.

For Question 2, mirroring the structure of Denny et al. [4], our survey asks SPMs to list up to five topics, skills, or abilities that should be taught within an undergraduate software product management course and why they think each is important. SWEs do not answer this question as the role of the SPM has additional responsibilities outside of the software team. Question 3 asks SWEs and SPMs to explain an SPM's value to software teams. The demographic questions (see Section 2.3) help the researchers understand the survey population.

### 2.2 Study Execution

We administered the survey via Qualtrics per IRB #26812 and recruited participants through personal networks, LinkedIn, and NCSU's alumni newsletter. To extend beyond our personal networks, we adopted snowball sampling [23], allowing respondents to optionally recruit others by forwarding an anonymous link to the survey. The study ran for 14 weeks. The collection ended after no additional responses were received for a week, yielding 131 responses, with 59 responses from product-focused individuals (i.e., SPMs), 63 from engineering-focused individuals (i.e., SWEs), and 9 from neither.

**Table 1: Demographic information for the 67 respondents (30 SWEs and 37 SPMs) who partially or fully responded to the questions.**

| | SPMs | | SWEs | | Total | |
|---|---|---|---|---|---|---|
| | # | % | # | % | # | % |
| **Years of Industry Experience** | | | | | | |
| < 1 | 1 | 1% | 2 | 3% | 3 | 4% |
| 1–3 | 1 | 1% | 5 | 7% | 6 | 9% |
| 3–5 | 3 | 4% | 2 | 3% | 5 | 7% |
| 5–10 | 10 | 15% | 5 | 7% | 15 | 22% |
| 10+ | 22 | 33% | 15 | 22% | 37 | 55% |
| Opt Out | 0 | 0% | 1 | 1% | 1 | 1% |
| **Total** | **37** | **55%** | **30** | **45%** | **67** | **100%** |
| **Education** | | | | | | |
| Some College | 0 | 0% | 1 | 2% | 1 | 2% |
| Professional | 1 | 2% | 0 | 0% | 1 | 2% |
| Bachelor's | 14 | 22% | 16 | 25% | 30 | 46% |
| Master's | 22 | 34% | 7 | 11% | 29 | 45% |
| Doctorate | 0 | 0% | 4 | 6% | 4 | 6% |
| **Total** | **37** | **57%** | **28** | **43%** | **65** | **100%** |
| **Gender** | | | | | | |
| Female | 11 | 17% | 5 | 8% | 16 | 24% |
| Male | 24 | 36% | 23 | 35% | 47 | 71% |
| Opt Out | 1 | 2% | 2 | 3% | 3 | 5% |
| **Total** | **36** | **55%** | **30** | **45%** | **66** | **100%** |

## 2.3 Participants

Of the 122 survey responses from product- or engineering-focused individuals, 67 (54%) provided optional demographic data, which is summarized in Table 1. Of the 67 respondents, the majority had at least *5-10* (15, 22%) or *10+* (37, 55%) years of experience; both SPMs and SWEs had majorities in 10 or more years of experience. Product-focused respondents predominantly held master's degrees, whereas engineering-focused respondents held more bachelor's degrees. Respondents also had the option to list their company, revealing a portfolio of at least 24 companies with diverse sizes and products, including: Amazon, Anthropic, Bandwidth, Bank of America, Buildertrend, CommerceHub, DaVinci Education Inc., Digital Turbine, DigitalOcean, Endor Labs, Fortinet, Google, IBM, LexisNexis, Meta, Microsoft, Oracle, Pendo, Procter & Gamble, Prometheus Group, Redfin, Rithum, SAS Institute, and Vistaly.

## 2.4 Data Analysis

To address RQ1 and RQ2, we used the open card sorting process described by Zimmerman for a qualitative analysis of the survey responses [36]. This method defines three phases – preparation, execution, and analysis – allowing themes to emerge directly from the data rather than using predefined categories following a closed card sorting process [26]. This same process was used for the papers on which the survey methodology is based [1, 4, 15].

The card sorting process was used for both RQ1 (Question 2 in Figure 1) and RQ2 (Question 3 in Figure 1), resulting in two separate open card sorts named *SPM Education* and *SPM Value*, respectively. In the *preparation phase*, the data was organized in a spreadsheet so that each free-text response had its own row. After reviewing the data and observing that some responses had compound statements, the first author manually read through and split up responses so that each row described one key point. For example, from *SPM Value*, the response,

> *"Coordinating with other stakeholders within the organization and providing clarity about next steps to continue iterating upon the product and delivery value to its users."*

was split into:

a. *"Coordinating with other stakeholders within the organization"*
b. *"providing clarity about next steps to continue iterating upon the product and delivery value to its users."*

After splitting the responses, each part was considered a *card*. A unique identifier was added to each card so that every response correlated to a number, and each segment was assigned a letter. In the previous example, representing the 21st response, the labels are *21a* and *21b*. Color coding was used to map the response to the participants' role communicated through Question 1. The *SPM Education* card sort, starting with 111 responses, resulted in 116 cards, and the *SPM Value* card sort, beginning with 72 responses, ended with 85 cards.

For the *execution phase*, each card sort was implemented by a pair of researchers, with authors two and three working on *SPM Education* and authors four and five on *SPM Value*. Each pair sorted the cards individually and then collaborated to combine and iteratively refine the categories. For the *analysis phase*, the first and sixth authors worked with each card-sorting pair to identify the overarching themes describing groups of categories. Both finalized card sorts for *SPM Education* and *SPM Value* can be found in Sections 3 and 4, respectively.

For the results from each card sort, references to a category, within the text and table, follow a three-digit format (x.x.x). The first number represents the specific card sort, where *SPM Education* is 3 (as results are in Section 3) and *SPM Value* is 4 (as results are in Section 4). The themes from each card sort map to the second number, and the categories map to the third number. For example, 3.1.5 references the *SPM Education* card sort, the first theme – *Business Knowledge* – and the fifth category *Prioritization*. Similarly, 4.3.1 is from the *SPM Value* card sort, under the *Communication* theme and from the *Customer* ↔ *Team* category. If a direct quote is used, the respondent type and the card's unique identification will be used (i.e., $SPM_{\#}$, $SWE_{\#}$) before the quote.

# 3 Results: RQ1, *SPM Education*

The results of this card sort, shown in Table 2, contain 116 cards from Question 2 of the survey asking SPMs: *Based on your experience, what topics, skills, or abilities should be taught?* The research team identified 21 competencies (i.e., card sorting categories) that describe the topics, skills, and abilities that SPMs believe should be taught to future software product managers within CS. From these competencies, we distilled three primary themes – *3.1 Business Knowledge*, *3.2 Technical Knowledge*, and *3.3 Soft Skills*. These themes contain approximately one-third of the total cards (30% to 37%), ranging from six to eight categories. Next, we describe each competency and provide direct participant quotes on its importance.

**Table 2: *RQ1 SPM Education* Card Sort Results. Percentages represent column percentages. Bolded rows are aggregation rows.**

| Competency | Topics, Skills, and Abilities | Total | |
|---|---|---|---|
| | | # | % |
| **3.1 Business Knowledge** | | **43** | **37%** |
| 3.1.1 Understanding the Customer | User Discovery, Customer Engagement, Usability Studies, User Research, Customer Interviews | 11 | 9% |
| 3.1.2 Product Sense | Defining Product Sense and Strategy, Balancing Pragmatism and Theory | 9 | 8% |
| 3.1.3 Market Research & Understanding | Market and Competitor Analysis | 6 | 5% |
| 3.1.4 Data-Driven Decision Making | Key Performance Indicators, Objective and Key Results, Collecting and Leveraging Data to Defend Decisions | 5 | 4% |
| 3.1.5 Prioritization | Roadmap Development, Prioritization Frameworks, Systems Thinking | 5 | 4% |
| 3.1.6 Marketing & Go to Market | Financial Analysis and Planning, Sales, Marketing, Go to Market, and Branding | 4 | 3% |
| 3.1.7 Understanding the Problem | Problem Discovery and Decomposition | 3 | 3% |
| **3.2 Technical Knowledge** | | **38** | **33%** |
| 3.2.1 Software Development Skills | Serviceability, Evolvable Design, Continuous Integration and Delivery, Relevant Technical Jargon, Testing | 11 | 9% |
| 3.2.2 Data Analysis | Statistics (Probabilistic and Bayesian), Data Science, Data Intelligence, and Product Analytics | 6 | 5% |
| 3.2.3 Design Thinking | Solution Shaping, Persona Identification, Empathy Mapping, Problem Solving | 6 | 5% |
| 3.2.4 Domain-Specific Knowledge | Cognitive Science, Psychology, Artificial Intelligence, Microeconomics, Industrial Design, and Ergonomics | 5 | 4% |
| 3.2.5 Human-Computer Interaction | Prototyping, Visual Design (UI/UX), Human-Computer Interaction | 5 | 4% |
| 3.2.6 Software Development Methodologies | Software Product Life Cycles, Minimal Viable Product, Software Development Frameworks, Agile, Scrum | 5 | 4% |
| **3.3 Soft Skills** | | **35** | **30%** |
| 3.3.1 Stakeholder Communication | Stakeholder Alignment, Knowing Your Audience, Defending Decisions, Demystify Technical Jargon | 10 | 9% |
| 3.3.2 Interpersonal Communication | Succinct and Clear Communication, Facilitation, Public Speaking | 9 | 8% |
| 3.3.3 Writing | Persuasive Writing, Technical Writing, and General Writing Skills | 5 | 4% |
| 3.3.4 Conflict Resolution | Escalation Management, Adaptability, Flexibility, and Conflict Resolution | 3 | 3% |
| 3.3.5 Critical Thinking | Critical Thinking | 2 | 2% |
| 3.3.6 Empathy | Empathy | 2 | 2% |
| 3.3.7 Leadership | Leadership, Influence | 2 | 2% |
| 3.3.8 Time Management | Time Blocking, Boundaries, Organization, and Time Management | 2 | 2% |
| | **Total** | **116** | **100%** |

## 3.1 Business Knowledge

With 43 cards (37%), this theme describes business-related competencies. These include the need for product sense, understanding the customer, and understanding the problem. Additionally, this theme encompasses marketing competencies and business analytics.

*3.1.1 Understanding the Customer (11 cards, 9%).* By deeply understanding the customer, the SPM can better understand how to solve their problem and create an effective solution.

> $SPM_{58a}$: *"Understanding user needs is critical for building successful products…PMs can gather insights, empathize with users, and prioritize features that solve real problems…"*

*3.1.2 Product Sense (9 cards, 8%).* Understanding the details of the product to help drive successful product development with a vision and strategy.

> $SPM_{39a}$: *"This is essential for ensuring alignment between technical and business teams. A clear product vision guides prioritization and helps articulate the 'why' behind decisions, driving successful product development. Teaching this enables students to focus on value and long-term goals."*

*3.1.3 Market Research & Understanding (6 cards, 5%).* The SPM must understand competitors to continually provide value to the business and customers.

> $SPM_{68a}$: *"Understanding competitive landscape and how to provide more competitive (if not completely novel) solutions"*

*3.1.4 Data-Driven Decision Making (5 cards, 4%).* When making decisions, an SPM should tell the story behind the data to support their reasoning.

> $SPM_{14a}$: *"Telling the story of why a decision was made, what information and data was used to make that decision"*

*3.1.5 Prioritization (5 cards, 4%).* Utilizing different frameworks to effectively prioritize tasks and goals.

> $SPM_{76a}$: *"PMs must balance competing priorities and manage trade-offs. Learning to create a product roadmap and prioritize features helps ensure alignment with business goals, efficient resource use, and timely delivery."*

*3.1.6 Marketing & Go to Market (4 cards, 3%).* The SPM must understand the best tactics for selling.

> $SPM_{12a}$: *"Learn how to identify a target market, product positioning, pricing your product, sales vs. product led growth, and actually launching a product or features. For launching, understanding when and how to scale a roll-out in phases, setting up A/B or multi-variate tests, and measuring success."*

*3.1.7 Understanding the Problem (3 cards, 3%).* The SPM must first understand the problem the product will be solving.

> $SPM_{8a}$: *"Survey the various methods of research into understanding the universe of opportunities and problems to solve and how to synthesize that research into actionable work."*

## 3.2 Technical Knowledge

This theme, the second largest in the card sort at 33% with 38 cards, covers the technical aspects of the job. While the role does not revolve around writing code, the SPM should have an understanding of software development processes and the capabilities of related technologies. Technical knowledge is also needed to analyze relevant data about product usage.

*3.2.1 Software Development Skills (11 cards, 9%).* The SPM should understand their developers, technical vocabulary, and software testing.

> $SPM_{109a}$: *"PMs need to understand basic tech concepts like APIs, AI use cases, basics of code, etc."*

*3.2.2 Data Analysis (6 cards, 5%).* An SPM must be proficient in data collection and analytics.

> $SPM_{104a}$: *"…the ability to look at data find trends, anomalies and action on them"*

*3.2.3 Design Thinking (6 cards, 5%).* Understanding the thought processes behind designing the product.

> $SPM_{9a}$: *"Understand design thinking methods and rapid iteration of ideas using prototypes"*

*3.2.4 Domain-Specific Knowledge (5 cards, 4%).* SPMs must also be willing to learn other subjects, such as cognitive science, psychology, or artificial intelligence, that are related to the product.

> $SPM_{61b}$: *"Understand human behavior and decision making"*

*3.2.5 Human-Computer Interaction (5 cards, 4%).* The knowledge and skills relating to how people interact with technology and designing products accordingly.

> $SPM_{108a}$: *"Understand how people interact with tools"*

*3.2.6 Software Development Methodologies (5 cards, 4%).* The knowledge of how software is developed and the common practices that align with the industry (e.g., Agile, Scrum) to understand the possibilities and limitations of the team and product.

> $SPM_{15a}$: *"Knowing what engineers do, how software comes to life, how software releases work, how coding works (not actually knowing how to code - that's not as useful). General understanding of what makes something more difficult to create in code than something else."*

## 3.3 Soft Skills

This card sorting theme, containing 35 cards (30%), revolves around an SPM's ability to interact with others, through written or verbal communication, leadership, and empathy. It includes other soft skills such as time management, conflict resolution, and critical thinking.

*3.3.1 Stakeholder Communication (10 cards, 9%).* When communicating with various stakeholders, the SPM can translate and standardize language across the customers, business, and team.

> $SPM_{101a}$: *"This is something that I wish I had learned in school! Keeping stakeholders in the company aligned on what you're trying to achieve is key. This will ensure the customer gets a consistent message, and that customer facing stakeholder groups are consistent in their communications. Also, some of the best ideas and feedback come from internal sources within the company!"*

*3.3.2 Interpersonal Communication (9 cards, 8%).* The SPM should have general communication skills to convey their message clearly.

> $SPM_{31a}$: *"I often find that it's not what you say, but how you say it"*

*3.3.3 Writing (5 cards, 4%).* The SPM should be able to write persuasively and technically for any audience.

> $SPM_{89a}$: *"Writing is the most important communication method we have in business."*

*3.3.4 Conflict Resolution (3 cards, 3%).* Being able to address and resolve any disagreements or communication issues.

> $SPM_{4a}$: *"…the ability to manage the situation, de-escalate tension, and leverage leadership to direct chaos to an organized resolution."*

*3.3.5 Critical Thinking (2 cards, 2%).* The SPM must think critically about problems and solutions.

> $SPM_{106a}$: *"Share examples of bad product decisions. Help new PMs learn from other PMs failures."*

*3.3.6 Empathy (2 cards, 2%).* The SPM should understand what others think and feel, including users, stakeholders, and developers, as it is *"Core to the job"* ($SPM_{51a}$).

*3.3.7 Leadership (2 cards, 2%).* The SPM must lead through influence rather than through authority.

> $SPM_{86a}$: *"...Being able to lead - to hear all the voices and make people feel heard, to move towards consensus, or to make the call and make it stick if you have to - is going to be crucial."*

*3.3.8 Time Management (2 cards, 2%).* Using one's time efficiently and effectively.

> $SPM_{17a}$: *"Multitasking and context switching are some of the hardest parts of the job. How do you build discipline and the ability to focus…"*

**RQ1 Summary:** Among all the topics, skills, and abilities that software product managers want to be taught to undergraduate CS students, the competencies are split nearly equally among business knowledge, technical knowledge, and soft skills.

# 4 Results: RQ2, *SPM Value*

The results of this card sort contain 85 cards from Question 3 of the survey asking both SWEs and SPMs: *What value do software product managers add to a team?* Of these cards, 35 were from SWEs, and 50 were from SPMs, where each perspective has a distinct column, as shown in Table 3. The SPM's value to a software team can be described in three primary themes – *4.1 Planning*, *4.2 Context*, and *4.3 Communication* – encompassing ten categories. Each category is briefly described in the table, and example cards from both respondent groups are in the text.

**Table 3: SPM Value Card Sort Results. Percentages represent column percentages. Bolded rows are aggregation rows.**

| Category | Description | Total | | SWE | | SPM | |
|---|---|---|---|---|---|---|---|
| | | # | % | # | % | # | % |
| **4.1 Planning** | | **43** | **51%** | **17** | **49%** | **26** | **52%** |
| 4.1.1 Direction | Aligns the team to a common goal | 23 | 27% | 9 | 26% | 14 | 28% |
| 4.1.2 Priorities | The prioritization of tasks to maximize efficiency when it comes to time, constraints, and relative importance of features | 10 | 12% | 3 | 9% | 7 | 14% |
| 4.1.3 Vision | Applying the SPM's knowledge to a tangible plan (i.e., roadmaps) and creates accessible goals along the way | 10 | 12% | 5 | 14% | 5 | 10% |
| **4.2 Context** | | **23** | **27%** | **6** | **17%** | **17** | **34%** |
| 4.2.1 The Grand Scheme of Things | Understanding the bigger picture of various constraints to coordinate effective product development | 8 | 9% | 2 | 6% | 6 | 12% |
| 4.2.2 Business & Market Context | Being aware of market and competitor trends to drive decision making | 5 | 6% | 1 | 3% | 4 | 8% |
| 4.2.3 Customer Context | Knowing the customer inside and out to deliver a valuable product that a customer wants | 5 | 6% | 1 | 3% | 4 | 8% |
| 4.2.4 Developer Context | Helps provide the reasoning behind product decisions for the developers to provide greater insight into product development | 5 | 6% | 2 | 6% | 3 | 6% |
| **4.3 Communication** | | **19** | **22%** | **12** | **34%** | **7** | **14%** |
| 4.3.1 Customer ↔ Team | Translating customer needs to technical requirements and the team's capabilities to the customer | 9 | 11% | 4 | 11% | 5 | 10% |
| 4.3.2 Stakeholder Coordination | Communicates the intricacies of the product, provides feedback, and knows who to consult for specific knowledge | 7 | 8% | 5 | 14% | 2 | 4% |
| 4.3.3 When NOT to Talk | Interfacing between the development team and customers or stakeholders to allow for efficient work time for the team | 3 | 4% | 3 | 9% | 0 | 0% |
| | **Total** | **85** | **100%** | **35** | **100%** | **50** | **100%** |

## 4.1 Planning

As the largest theme, containing 51% (43 cards) of the cards and the top category for both SWEs (49%) and SPMs (52%), this theme presents the usefulness of an SPM's skill of providing direction, prioritization, and goal orientation.

*4.1.1 Direction (23 cards, 27%).* The SPM owns the vision of the product and can effectively provide clarity through its direction, maintaining focus and ensuring goals are met with proper planning and roadmapping.

- $SPM_{9a}$: *"Clarity and direction"*
- $SWE_{42a}$: *"Take the noise of customer complaints and external team asks and create a powerful signal for what the team should be doing next to maximize ROI."*

*4.1.2 Priorities (10 cards, 12%).* The SPM plays a critical role in understanding the constraints and goals of the product to effectively realize the rankings of importance and the prioritization of specific tasks or resources across different teams.

- $SPM_{25a}$: *"There are endless ideas for what to create next or what features to enhance. Most of these ideas are really good and would have a positive impact on our customers. However, resources are limited. We don't have the time or resources to do everything . . . "*
- $SWE_{59a}$: *"The hardest thing: Tell an internal or external customer no. We don't need to kill the thing, it just needs to be appropriately prioritized within the queue . . . "*

*4.1.3 Vision (10 cards, 12%).* The SPM takes the knowledge accumulated from the *4.2 Context* theme and applies it to planning out the product (i.e., roadmaps) to provide a succinct justification for the prioritization and direction of the team.

- $SPM_{33b}$: *"By defining a well-articulated product vision, roadmap, and set of priorities based on user needs and business objectives, the PM ensures that engineers focus on building the right features that drive the most value. This alignment reduces ambiguity, fosters collaboration, and helps engineers deliver impactful solutions efficiently."*
- $SWE_{50a}$: *"Vision and high-level direction. Without a product manager, engineering teams can often find themselves lost 'in the weeds' . . . due to not understanding the user value being provided."*

## 4.2 Context

The SPM must understand the full scope of the product and customer base to convince stakeholders *why* the product is necessary and valuable. This theme contains 6 cards from SWEs and 17 from SPMs, totaling 23 cards (27%) of the *SPM Value* card sort.

*4.2.1 The Grand Scheme of Things (8 cards, 9%).* The SPM is very familiar with the product. This includes the problem the product addresses and the context surrounding the problem (i.e., constraints, time, etc.). They serve as the link between the business and customer contexts.

- $SPM_{8a}$: *"The ability to synthesize many disparate pieces of qualitative and quantitative information into a compelling story about what to do, why it's important, and how to go about solving the problem (at a high level)."*
- $SWE_{65a}$: *"Single point of contact for questions regarding a product's development"*

*4.2.2 Business & Market Context (5 cards, 6%).* The SPM understands *"Business alignment"* ($SWE_{47a}$) and *"market insights"* ($SPM_{36b}$). They can effectively consider these when making decisions about the product. Ultimately, the PM is aware of the market and how their business can be affected by the product.

*4.2.3 Customer Context (5 cards, 6%).* The SPM listens to the customers' needs, wants, concerns, and questions. The SPM must be

extremely familiar with the customers' perspective to plan the product effectively and optimize customer satisfaction.

- $SPM_{5a}$: *"A constant lens and exposure, qualitatively, to 'what is most valuable to the customer' via direct customer interviews, industry experience–combined with the use of evidence-based (read: hard data) methods that reinforce quantitatively the scale/impact/market for solving those problems well."*
- $SWE_{62a}$: *"A deep understanding of the customer and how our product(s) provide value to them."*

*4.2.4 Developer Context (5 cards, 6%).* The SPM helps developers understand the purpose of the product they are building, through the intended goals by including how and why it will be used.

- $SPM_{16a}$: *"Context and guidance. The best PMs are the ones who provide the 'why' well enough that the engineers can be left to figure out the 'how' while feeling inspired, in-the-loop, and free to make smart software decisions."*
- $SWE_{61a}$: *"Context - What are we implementing and why?"*

## 4.3 Communication

Lastly, the communication theme describes the various groups with which the SPM must communicate. As the smallest theme (19 cards, 22%), it also has the most significant difference in the number of cards between the SPMs (7 cards, 14%) and SWEs (12, 34%).

*4.3.1 Customer ↔ Team (9 cards, 11%).* The SPM serves as the communication link between the customers and the developers. The SPM tells the software team what the customers want, gives feedback, and provides the customers with the product's progress, launches, and constraints. The SPM is responsible for taking information from the customer and market contexts and properly organizing the development team to promote product success.

- $SPM_{22a}$: *"Transparency. Software teams are often left in the dark on key decisions. It is vital the PM proactively involve the engineering teams into business discussions and always provide clear reason for any change in direction. Being transparent and candid goes a long way to building a team of trust."*
- $SWE_{57a}$: *"Bridging the gap between engineering team limitations and customer expectations"*

*4.3.2 Stakeholder Coordination (7 cards, 8%).* The SPM serves as the communication link between stakeholders and the business. The SPM keeps all the stakeholders in the loop regarding what the business needs and what they can do, and communicates to the business what the stakeholders want.

- $SPM_{21a}$: *"Coordinating with other stakeholders within the organization"*
- $SWE_{66a}$: *"Communication with stakeholders when we are experiencing roadblocks."*

*4.3.3 When NOT to Talk (3 cards, 4%).* The SPM can recognize ideal times for communication and acts as a roadblock for the development team to work and not get distracted. For example, $SWE_{55a}$: *"Embodying knowledge and responsibilities that allow other team members to focus within their specialties while still maintaining access to each other."*

**RQ2 Summary:** According to SWEs and SPMs, the primary value the SPM role provides to a software team can be categorized through their skills of planning, understanding the relevant context, and communication. Both respondent groups believe an SPM's ability to plan is the most valuable in that they provide the direction, priorities, and vision for the team.

# 5 Related Work

With the recent emergence of the SPM role, several research groups have sought to clarify its responsibilities. In this section, we first outline current and prescriptive literature distinguishing the SPM role. We then directly compare our results to prior empirical work, resulting in Table 4.

## 5.1 Defining the SPM Role

Ebert clarifies the software product management role by comparing it to product marketing and project management in addition to its importance to the industry [6]. Majka further distinguishes the role from project managers [20]. Also, in many business environments, the product owner and product management job titles can be used synonymously [34]; their responsibilities can overlap and even commonly work with each other [11, 31, 34]. Toikkanen et al. find that product owners often do not work directly with customers and attribute the customer-driven value to the SPM role [32].

Ebert and Brinkkemper outline the SPM role [7] more formally, laying the foundation for the prescriptive literature, the SPMBoK [17]. The SPMBoK categorizes the responsibilities of an SPM based on their level of involvement within a typical software organization: acting as a participant (i.e., strategic management), executing core responsibilities (i.e., product strategy, product planning), and orchestrating others (i.e., development, marketing, sales and fulfillment, delivery services and support). In addition to product planning and strategy, their core responsibilities include market and product analysis within the larger strategic management organization [17]. The ISPMA highlights that orchestrating other responsibilities is also a core part of the SPM's job, even if the specifics vary between businesses.

## 5.2 SPM Competencies

While the majority of software product management literature has sought to *define* the role, this paper instead identifies the skills that SPMs wish they had learned to be successful. This section directly compares our findings from *SPM Education* to the current software product management literature that identifies a distinct list of competencies to define the role; the juxtaposition of the competencies is shown in Table 4. The first and sixth authors used closed card sorting [26] (i.e., predefined categories) to map the empirical literatures' competencies, with no duplicates, to the *SPM Education* results from Section 3. For example, the competency *"Negotiation Skills"* in Ebert's study [5] (second column in Table 4) was sorted into the *SPM Education* competency of *3.3.1 Stakeholder Communication*. We discuss each of the five papers in relative order according to the table.

Ebert [5] describes the importance of having an SPM acting as a *mini-CEO*, which ultimately improves handover quality and reduces delays by 80% compared to companies that do not employ them [5]. In Ebert's study, after analyzing an SPM's effect on the

**Table 4: Alignment between *SPM Education* in Table 2 and Prior Work**

| Category | Ebert [5] | Maglyas et al. [19] | Rachitsky [25] | Sipos and Szabó[1] [28] | Springer and Miler [29] |
|---|---|---|---|---|---|
| **3.1 Business Knowledge** | | | | | |
| 3.1.1 Understanding the Customer | – | – | – | Customer-Centric Thinking (C), Customer Research (R), Usability Testing (R) | – |
| 3.1.2 Product Sense | Define Business Objectives | Strategy Planning | Product Sense, Strategic Thinking | Product Strategy (R) | – |
| 3.1.3 Market Research & Understanding | – | – | Business Acumen | – | Curiosity of the World |
| 3.1.4 Data-Driven Decision Making | – | Information Resources, Decision Making | Data Acumen | Decision making (C), KPI Definition (R) | Decision Making |
| 3.1.5 Prioritization | Balance Trade-Offs, Roadmap | Creation of Roadmaps, Define Tactical Actions | Execution | Roadmap Management (R), Prioritization (R), Resource Allocation (R) | – |
| 3.1.6 Marketing & Go to Market | – | Own Product Budget | – | GTM Strategy (R) | Knowledge of Business Analysis |
| 3.1.7 Understanding the Problem | Manage Risks and Uncertainty | – | – | Requirement Collection (R), Risk Assessment (R) | Understand the Problem Domain |
| **Not Aligned** | – | Hiring | – | – | – |
| **3.2 Technical Knowledge** | | | | | |
| 3.2.1 Software Development Skills | Understand SW- and IT- tools | – | Technical Acumen | – | – |
| 3.2.2 Data Analysis | – | – | – | Product Performance (R) | Data Analysis and Synthesis |
| 3.2.3 Design Thinking | – | – | – | Problem Solving (C) | Interface Prototyping |
| 3.2.4 Domain-Specific Knowledge | **Not Aligned** | | | | |
| 3.2.5 Human-Computer Interaction | – | – | Design/UX | Product Planning and UX (R) | Understanding Human Behavior |
| 3.2.6 Software Development Methodologies | Product Life Cycle Management | Orchestration of Development | – | Development Life Cycle (R) | – |
| **3.3 Soft Skills** | | | | | |
| 3.3.1 Stakeholder Communication | Accountability, Negotiation Skills, Teamwork | – | Collaboration | Teamwork (C), Stakeholder Management (C), Stakeholder Relationships (R), Cooperation (R) | Negotiation, Teamwork, Networking |
| 3.3.2 Interpersonal Communication | – | Communication | Communication | Communication (C), Active Listening (C) | Communication |
| 3.3.3 Writing | **Not Aligned** | | | | |
| 3.3.4 Conflict Resolution | – | Resolve Problems Between Departments | – | Conflict Management (C) | – |
| 3.3.5 Critical Thinking | – | – | Raw Intelligence | Adaptability (C), Creative Thinking (C), Critical Thinking (C) | Inquisitiveness, Perseverance, Willingness to Learn |
| 3.3.6 Empathy | – | – | Empathy | Empathy (C) | Open Mindedness |
| 3.3.7 Leadership | Leadership | Product Leadership | – | Leadership (C) | Assertiveness, Leadership Predispositions |
| 3.3.8 Time Management | – | – | – | Time management (C) | Consistency, Project Management |

[1] This column is an aggregated set of the competencies (C) and responsibilities (R) identified.

duration, delays, and quality of 178 projects, 10 topics are identified on what competencies help determine the product's success. In Table 4, Ebert's findings and RQ1 align for all categories except *"managing risks and uncertainty."* While the competencies described in Section 3 did not explicitly include one concerning risk, 3.1.7 *Understanding the Problem* describes how an SPM should discover and decompose the problem, which provides the foundation for recognizing and assessing any potential risks.

Through interviews with SPMs, Maglyas et al. [19] use a grounded theory analysis to develop the Software Product Management Roles Framework (SPMRF), which describes that the role of an SPM typically can mimic one of four personas depending on the company size, one's experience, and leadership capabilities [19]. The SPMRF provides contrary evidence that a single SPM cannot assume the responsibilities of all four personas and explains that the ideal *mini-CEO* (as described by Ebert [5]) can only be achieved through a product team. The SPMRF describes an SPM's role through 11 competencies organized into four primary categories: influence on product, authority, access to resources, and influence on collaboration. The competency of *"possibility to hire people"* does not align with the findings from RQ1, but would fall under the *3.1 Business Knowledge* theme. We suspect this category was present in their data and not ours because, from an undergraduate curriculum perspective, learning proper hiring processes becomes more relevant for experienced roles rather than for recent graduates.

In 2020, a survey was conducted by Lenny Rachitsky, a popular software product management podcast host, with responses representing over 600 companies and almost 1000 participants. It identified the best ways to get promoted as an SPM and how much influence the role has [25]. The survey found that communication,

execution, and product sense are the most valuable when hiring, and the top-11 skills map to the competencies from RQ1. Given that this survey had approximately 7x as many respondents as ours, and our categories encompass all their categories, it suggests our data captured a sufficiently diverse set of SPMs.

Within the Hungarian job market, Sipos and Szabó analyzed job postings for SPMs where they identified the most popular competencies and responsibilities required for the role [28]. They concluded that *"managing roadmaps, maintaining development life cycles, product strategy, communicating with stakeholders,"* and *"task prioritization"* are the most common responsibilities for this position [28]. The most frequently mentioned competencies include *"leadership, communication, empathy,"* and *"adaptability."* This comparison of 29 competencies and responsibilities is almost a direct match to our findings; however, their categories are missing the following from our data: *3.1.3 Market Research & Understanding* and *3.2.1 Software Development Skills*. Job advertisements aim to be concise; to do this, competencies are often grouped. We speculate that *3.1.3 Market Research & Understanding* can be grouped with their responsibility of *"product strategy"* since it would be assumed that a product fills a gap in the market. The competency of *3.2.1 Software Development Skills* assumes that the SPM was previously an SWE or similar, which may not be representative of the jobs analyzed.

To further differentiate how company structure can affect the role, Springer and Miler conducted interviews with SPMs working at companies with differing sizes and product delivery models [29]. Their interviews identified the primary objectives and responsibilities of the SPM in each company. They formulated a general archetype of what an SPM should be capable of [29]. The competencies that they defined are directly mapped to our findings.

The work from Ebert and Brinkkemper [7], which provides some early results from which the ISPMA framework within the SPMBoK was developed, and the SPMBoK [17] are not empirical studies and are therefore not considered in Table 4. However, the ISPMA framework identifies *Legal & IPR Management* (e.g., intellectual property management, governance, licensing) as a core responsibility. This does not align with our RQ1 results or with any of the other empirical papers.

*5.2.1 Weak Alignment.* When situated within the prior empirical literature, two of the 21 competencies – *3.2.4 Domain-Specific Knowledge* and *3.3.3 Writing* – do not align. While these papers aimed to identify the differences in the role depending on the size and structure of the company, there is no clarification that an SPM must dive deeper into product-relevant topics (i.e., cognitive science, artificial intelligence, microeconomics). This observation could lend to the fact that the SPM must acquire, in a more general sense, knowledge through the customer, market, and stakeholders. Also, it is possible that in the prior work, *3.3.3 Writing* would fall under a more general communication umbrella, but in our data, it was explicitly identified as an important skill.

*5.2.2 Strong Alignment.* While no competency was mentioned in every paper, as seen in Table 4, six of the 21 competencies are referenced in four of the five studies. These competencies – *3.1.2 Product Sense*, *3.1.4 Data-Driven Decision Making*, *3.1.5 Prioritization*, *3.3.1 Stakeholder and 3.3.2 Interpersonal Communication*, and *3.3.7 Leadership* – all fall into the *3.1 Business Knowledge* and *3.3 Soft Skills* themes defined in RQ1. The *3.2 Technical Knowledge* theme was more aligned with papers that looked at job advertisements for specific products [28] or the role's responsibilities in different business contexts [29].

## 5.3 SPM Education

On the education side, Pawar et al. sought to develop a program for software engineering graduate students, with an optional concentration in product management, emphasizing the importance of a product perspective [24]. The product management track assumes the student has worked in industry and understands software development technologies. Pawar et al. compare their curriculum to three popular programs helping students develop their product management knowledge [3, 33, 35].

Their required SPM course maps directly to the competencies identified in RQ1: *"identifying customer needs"*(*3.1.1 Understanding the Customer* and *3.1.7 Problem*), *"defining value proposition"* (*3.3.1 Stakeholder Communication*), *"specifying and validating MVPs"* (*3.2.6 Software Methodologies*), *"building products with Agile and Scrum"* (*3.2.6 Software Methodologies*), and *"product measurement and metrics"* (*3.2.2 Data Analysis* and *3.1.4 Data-Driven Decisions*).

# 6 Discussion

In this section, we explore the student learning objectives (SLOs) from an SPM undergraduate course at NCSU, and compare them against the results from *SPM Education* and *SPM Value*, with suggestions for achieving better alignment moving forward.

In NCSU's undergraduate ABET-accredited CS curriculum, courses are often paired with group projects on medium-scale software projects [13]. This prepares students for a senior capstone course in which they partner with a company to simulate industry practices [27]. To prepare students for SPM roles, product-focused principles should be taught in an undergraduate setting, allowing students to develop a product mindset in tandem with their software engineering knowledge.

In the Senior Design capstone course, a team of four to six senior undergraduates interacts with company representatives for a semester, following best practices with frequent meetings with their stakeholders and faculty. Faculty advising allows students to understand the software engineering role to counteract misconceptions about the field [14, 30]. The senior design course [2, 10] focuses explicitly on *3.2.1 Software Development Skills* through the student learning objectives related to the specification, design, and implementation of a system. It also focuses on *3.3.2 Interpersonal Communication*, *3.3.1 Stakeholder Communication*, and *3.3.3 Writing* through the SLO *"that students will be able to communicate effectively about computer science-related topics"* where the outcomes include an *"audience-sensitive oral technical presentation"* and *"audience-sensitive technical document."* Among the top five competencies from RQ1, three are covered, which leaves *3.1.2 Product Sense* and *3.1.1 Understanding the Customer*. These competencies are just emerging in our curriculum through the introduction of a senior-level course on Software Product Management, which launched in Fall 2023.

This Software Product Management course, offered as an elective to seniors, focuses on developing a *product mindset* emphasizing

the importance of defining product purpose, scope, and discovery of user needs. The SLOs, which were drafted prior to this research, are mapped to competencies from RQ1 in Table 2, as follows:

(1) Identify unmet customer needs for a software product (3.1.1 *Understanding the Customer* and 3.1.7 *Problem*)
(2) Create a feasible schedule for a team of software developers to improve the product to meet the customer needs (3.1.5 *Prioritization*)
(3) Create a plan for mitigating risk during a software project (Cross-cutting across 3.1 *Business Knowledge*)
(4) Examine and explain the business value for a software product (3.1.2 *Product Sense*)
(5) Use metrics to evaluate improvements to a software product (3.1.4 *Data-Driven Decision Making*)

Within the *3.1 Business Knowledge* theme, all competencies are covered by the current SLOs, with two exceptions: *3.1.3 Market Research & Understanding* and *3.1.6 Marketing & Go to Market*. These competencies may be better suited for a course in a business school, as the marketing and market research foci align less with the curriculum in a computer science department.

In the Senior Design capstone course, verbal and written communication primarily involves developers and business stakeholders rather than customers. To close this gap in the curriculum, students in the SPM course should learn strategies and best practices for communicating with stakeholders to *3.3.1 Demystify Technical Jargon* and relay their *3.1 Business Knowledge*.

Additionally, the three themes identified in *SPM Value* validate the SLOs described for the SPM class as they directly align with the top skills SPMs wished they had learned. The theme *4.1 Planning* requires the competencies of *3.1.2 Product Sense* and *3.1.5 Prioritization*. For the SPM to be valuable, they must also effectively understand the context about the customers, business, development team, and product, which encapsulates the *3.1 Business Knowledge*, and *3.2 Technical Knowledge* themes described in RQ1. Lastly, the SPM's value stems largely from their skills in communication and managing interactions between various stakeholders which directly maps to the *3.3.1 Stakeholder Communication* and *3.3.2 Interpersonal Communication* competencies. Since RQ2 provides perspectives from both SPMs and SWEs, this course prioritizes the skills necessary for an undergraduate SE student to be an asset to a software team.

The SPM course primarily revolves around a group project that spans most of the semester, where students identify a current product that interests them. They are then required to interview potential and current users to identify pain points. From the interviews and additional competitor and market research, the groups use data-driven decision making to propose a future direction and roadmap to maximize product success and mitigate risk. The students then generate relevant metrics to highlight potential risks and determine the best way to assess the product's success based on the proposed roadmap. Based on our findings, this curriculum supplements the current SE curriculum at NCSU. It exposes students to a product-focused perspective through the competencies SPMs wish they had learned, validated by the role's value to a software team.

## 7 Threats to Validity

**Internal Validity & Reliability.** Open card sorting is a human process that can result in many different outcomes. To mitigate this, groups of two or three researchers collaborated on the category creation; the descriptions and groups were iteratively refined to reach a consensus. A researcher (or two, for RQ2), not involved with the original card sorting process conducted a closed card sort with the now-defined categories from the open card sort with an accuracy of 67% for RQ1 and an average of 74% for RQ2, suggesting moderate agreement [21].

**Construct Validity.** According to Sipos and Szabó, only 16.5% of the job titles were explicitly *Product Manager* within the Hungarian software industry, which could lead to confusion regarding the role identification question in Figure 1. To combat this, our survey aggregated multiple similar roles, allowing the participant to decide if their role was product-focused, engineering-focused, or neither. This allowed us to capture opinions from people with product-focused jobs, even if their job title differed from *Product Manager*.

**External Validity.** Our data set of 131 respondents may not represent the beliefs of all types of software product managers, in that most respondents have five or more years of industry experience. However, our respondents come from a diverse set of at least 24 companies of various sizes and product delivery models. Additionally, our competency categories are a superset of a prior survey that encompassed over 7x the number of participants [25], suggesting sufficient coverage of the population.

## 8 Conclusion

The software product management role is increasing in demand, and Sipos and Szabó report that 84% of the largest United States companies contain some form of product management [28]. Our survey collected responses from 59 software product managers and 63 software engineers to identify the topics, skills, and abilities needed for future software product managers and to solidify the role's value in the software industry. Future curriculum and training should include competencies across three key themes: *business knowledge* (i.e., understanding the customer and market, product sense, prioritization), *technical knowledge* (i.e., software development skills and methodologies, data analysis), and *soft skills* (i.e., interpersonal and stakeholder communication, writing). By learning these competencies, the SPM is able to coordinate a plan for a product's direction, priorities, and vision to guide a software team. The SPM should effectively communicate a wealth of knowledge and context to many audiences to deliver the final product. Researchers should continue to identify the role's capabilities and how to overcome potential challenges. Educators should incorporate the product perspective and inform CS students about software product management to provide the foundation of *why* products should be developed through the value they provide to the customers.

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