



# Managerial and Professional Skills and Dispositions from Professionals' Interviews

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## ABSTRACT

Employability should be a primary objective for computing programs, as the majority of IT and other computing graduates go to work in industry upon graduation. Furthermore, students want to be prepared for a career, not just an entry-level job. However, literature has shown a gap between employers' needs and undergraduates' preparation in non-technical areas. Competencies (skills, knowledge, and dispositions) can be a common language used by both employers and educators. The more we learn about competencies employers expect, the more we can ensure programs match their expectations. This study focuses on competencies required by managers, by interviewing ten directors/managers, project managers, and product managers who had prior experience in computing-related roles. Each was asked to discuss competencies most important to their current position. Emerging themes identified the most important managerial skills (project management, evaluation of candidates, mentorship, managers' own technical skills and knowledge, adjusting management style as needed, and appropriately assigning team members), professional skills (communication, problem solving, and relationship building), and dispositions (lifelong learning; adaptability/flexibility; being self-driven; self-awareness; being helpful, positive and pleasant; valuing communication and collaboration; having passion for technical work; and perseverance). Implications for education are discussed. This study is part of a larger NSF-funded project related to investigating the competencies required by computing professionals, and the design of educational resources to promote the development of these competencies.

## CCS CONCEPTS

• Professional topics; • Computing education; • Computing education programs;

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## KEYWORDS

Competencies, Dispositions, Managerial skills, Professional skills

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## 1 INTRODUCTION & RELATED WORK

Managerial roles in the computing industry include project managers, IS/IT managers, supervisors and directors [9]. These managers oversee the successful completion of projects and attainment of team or company goals. All managers need to demonstrate competencies in the context of their business function, which are known to impact project performance [12]. As the computing industry becomes ever more integrated into other industries, managers need to adapt quickly and demonstrate relevant competencies to steer their teams in a direction that yields preferred company level outcomes, which requires new competencies to effect business and organizational impact [6, 17].

The construct of competency, as introduced to the computing education world in the IT2017 curricular report [14], includes knowledge, skills, and dispositions related to successfully performing goal-oriented tasks required in the workplace. Dispositions, such as open-mindedness, empathy, kindness, humility, and collaborative mindset [17], positively impact computing professionals' actions and enable them to know 'when' and 'why' to perform a certain task [7]. Hiring managers and executives indicate that professionals across industries should be self-motivated, able to work independently, and able to work with people of different backgrounds [8]. Professionals also require *professional skills* such as communication, problem solving, critical thinking, ethical reasoning, and teamwork [4, 8].

Most studies that identify competencies required by managers do not differentiate between professional skills and dispositions [12, 17]. Literature in this area associates these competencies with personality types that are suitable for different roles [4, 10, 19]. However, such competencies are not merely static attributes of one's personality; they can be learned and developed [5, 7]. Furthermore, the distinction between professional skills and dispositions is important, especially for educators, since the pedagogies used to

**Table 1: Participants demographic information**

| No. | Education                       | Years in IT | Industry sector              | Org size | Job title                        |
|-----|---------------------------------|-------------|------------------------------|----------|----------------------------------|
| 1   | BS CS, MBA                      | 22          | Finance                      | 11,800   | Business Relationship Manager    |
| 2   | BS EE, MS EE, MBA               | 40          | Communication                | < 500    | Executive Director, Product Dev  |
| 3   | BS Mathematics, MS CS           | 41          | IS                           | 4        | Owner                            |
| 4   | BS CS, MS & PhD IST             | 4           | Marketing                    | 56       | Engineering Manager              |
| 5   | BS CS; MS Computer Apps         | 14          | IT                           | >45,000  | Assistant Director of Technology |
| 6   | BA Television & Film Production | 20          | IT Consultation <sup>a</sup> | >45,000  | Associate Director of IT         |
| 7   | BS CS, MS CS                    | 9           | IT Consultation <sup>a</sup> | >45,000  | Associate Director               |
| 8   | BS MIS                          | 17          | IT Consultation <sup>a</sup> | >45,000  | Associate Director               |
| 9   | BA Physics                      | 23          | Finance                      | < 50     | Head of Developer Relations      |
| 10  | BS CS, MS CS, PhD CS            | 14          | Transportation <sup>a</sup>  | > 45,000 | Director of Research Operations  |

<sup>a</sup> These participants are members of consulting groups that are affiliated with a university but provide consulting services to outside organizations.

teach professional skills and dispositions may differ [11], allowing management and computing programs to align their curricula and foster appropriate competency development.

Managerial competencies are not only developed in professional graduate programs, e.g., MS IS or MBA, but also should be taught to undergraduates. Starting in the IT2008 curricular report [3], the knowledge area of “Social and Professional Issues” was added, to include *professional practice and social context of computing*. The IT2017 competency-based curricular framework introduced the essential competency domain “Global Professional Practice,” including *project management principles, communication, teamwork and conflict management, employability skills and careers in IT, professional skills and responsibilities*, etc. A supplemental competency domain “Social Responsibility” further added *goals, plans, tasks, deadlines and risk and risk management*. Similarly, ABET’s 2022-2023 accreditation criteria [1] include the IT-specific student outcome “use systemic approaches to select, develop, apply, integrate, and administer secure computing technologies to accomplish user goals.”

Learning from professionals what is required on the job helps us understand how to prepare students for not just their first job, but a career in computing. This exploratory qualitative study explores managerial and professional skills and dispositions, based on semi-structured interviews of 10 computing professionals in managerial roles. This study addresses the research question “What competencies do managers believe are most important to their current position?”

## 2 METHODOLOGY

Data included are part of a larger, NSF-funded study on competencies required by computing professionals. Ten participants in managerial roles were selected from 31 who took part in the larger study (see Table 1). A combination of purposeful sampling techniques [16], including link-tracing and criterion sampling [18], were used to identify participants. Team members sent the request for

participation to contacts in computing and to those who could forward to eligible participants. Respondents were asked to complete a questionnaire and those who matched the inclusion criteria were selected. Participants were requested to forward the invitation to their acquaintances in the computing industry who met the criteria and might be interested in participating. This was continued until sufficient participants in each job family (e.g., “managerial”) were interviewed. All participants had prior experience in IT, Software Development, or other computing-related roles and currently served in management, project management, or product management roles.

Hour-long semi-structured interviews were conducted with each participant. Questions relevant to this paper related to what participants do on a typical day, and what skills, knowledge, and dispositions are required on their job. Participants in managerial roles were also asked about hiring practices. Prior to collecting research data, four pilot interviews were conducted and researchers refined the protocol (Click here to the final protocol). A simplified question list was sent to participants prior to the interview to review or add notes if they wished to do so. All the interviews were conducted online through Zoom or Microsoft Teams by two team members. Each interview was recorded, transcribed, and cleaned.

Using the competency construct for a theoretical framework, skills and dispositions were the primary initial themes in our coding hierarchy. The remainder of the analysis was driven by thematic analysis, an approach which follows the general steps: familiarizing yourself with the data, generating initial codes, searching for themes, reviewing themes, defining themes, and reporting the findings [15]. For this study, Dedoose qualitative analysis software was used for joint coding sessions. Two researchers coded each transcript together, continuously discussing and making notes on the meaning of emerging codes and grouping them under larger emerging themes. Prior coded transcripts were reviewed when new codes emerged along the coding process. After all transcripts were coded, codes were merged, renamed, or reorganized and excerpts were reviewed again. Codes relevant to managerial skills, professional

Table 2: Top five managerial skills

| No. | Skills                                                 | Number of participants | Number of excerpts |
|-----|--------------------------------------------------------|------------------------|--------------------|
| 1   | Project management                                     | 10                     | 33                 |
| 2   | Evaluate candidates                                    | 9                      | 30                 |
| 3   | Mentorship                                             | 7                      | 17                 |
| 4   | Have sufficient technical skills and knowledge         | 7                      | 13                 |
| 5   | Adjust management style to team members' personalities | 5                      | 14                 |
| 6   | Appropriately assign team members                      | 4                      | 10                 |

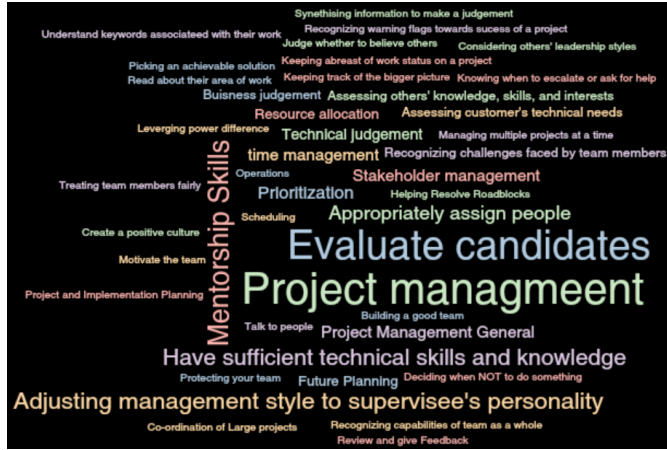


Figure 1: Word cloud of managerial skills

skills, and dispositions were included in this study; knowledge and technical skills as well as unrelated topics covered in the interview were not coded. The ten transcripts, including 109,301 words, were analyzed and 143 relevant codes were generated.

Credibility and trustworthiness (the qualitative equivalents of validity and reliability) were addressed in several ways, as recommended by [13]. Confirmability was in part addressed through the recording and verbatim transcription of the interviews and documentation of methods used. Dedoose kept track of emerging themes and codes, code descriptions, and linking codes to excerpts in each transcription. Credibility was addressed through researcher triangulation (the first three authors conducted analysis in pairs of two) and peer debriefing (results were reviewed with the 4th author). Trustworthiness was also addressed throughout the process through prolonged engagement with the data, use of a constantly evolving coding framework which was discussed throughout the coding process, vetting of themes by other team members, and documentation of our process [15].

There are several limitations to this study. Only ten participants were included, with smaller numbers in certain roles (e.g., only two were product managers). Five were from two consulting groups within one larger organization. Furthermore, only interviews were used; ideally, we might have used other sources for data triangulation. Because this is a qualitative study, there is no presumption

of generalizability. The alignment between our themes and existing literature on professional skills and dispositions increases our confidence in the transferability of the findings of this study.

### 3 RESULTS

#### 3.1 Managerial Skills

39 managerial skills were identified (Figure 1); the top six were mentioned by at least three participants (Table 2).

**3.1.1 Project Management.** All ten participants discussed project management skills, which broke into six sub-themes. Besides the general references to project management, three were mentioned by at least three participants.

Six participants mentioned their experience in **stakeholder management**, as described by one participant: “So in my case, I was managing the business and technology stakeholders so it did involve a lot of interaction with the business, not just the technology teams.” Usually, they needed to interact with internal “project managers, product managers, software engineers” to get necessary information about the projects, then manage clients’ expectations, for example, “explain to them what it looks like because of the systems and the framework limitation. If you are thinking of implementing this, we might not probably do it because of the limitations of the framework and then they will understand it.” Another described a difficult situation in which a technical problem, not caused by his team, needed to be fixed immediately:

“[Some problems] were really time bound...An example of that is a Wi-Fi network in a sports and entertainment arena that needed to be working properly for the NCAA Basketball tournament. Well the tournament is going to happen on the day it’s going to happen whether you’ve got it done or not, and if it’s not done, it’s really going to be an ugly situation. The pressure of getting it and analyzing what the problem was [and] coming up with a solution and getting it done on a specific time frame and this involved it. And you know doing construction work so there were contractors involved in getting them lined up to do it. Keeping the customer aware of what was going on and convincing them that we actually had the ability to solve the mess that we that these contractors had created previously.”

Four participants mentioned the importance of **prioritization**. One participant explained it very well:

“We always have competing priorities and we have a limited set of resources, so we’re kind of helping with prioritizing and doing the resource management at the same time.... I just act as the intermediary for the technology teams or represent them in the business discussions.”

Three participants felt “**Time management** is a big one... being able to... switch between multiple projects and multiple sponsors.... Having to bounce in and out of a project...in and out of meetings and finding the time throughout the day to still move everything forward can be a challenge.”

**3.1.2 Evaluate Candidates.** Nine participants discussed evaluating candidates in the hiring process. Most evaluated candidates’ foundational technical and programming skills, but did not expect candidates to have mastered specific technologies or languages, as one explained: “I was less inclined to look for skills that exactly matched what we were doing, realizing that there are so many tools and so many languages and so many areas of expertise...what I would tend to look at is did they have a background in a couple of different programming languages?” They also assessed candidates’ ability and willingness to learn, problem solving skills, level of initiative and to what extent they fit or match with the team and organization.

**3.1.3 Mentorship.** Seven participants talked about mentorship as an important part of their role. One had developed a training program for their organization. They emphasized the importance of assessing their team members’ current skill levels and needs. In some cases, they provided direct mentorship: “[I] like to sit with them line by line, debug the issue, and find out what’s the cause of the problem if they’re trapped in some of the issues for more than a week.” In other cases, they would pair mentees with more senior mentors. One discussed attending trainings, and returning to train other team members. Mentorship was also important for helping team members gain confidence. They saw their role as helping their team members grow, although they recognized that this could not come at the cost of business goals, as one explained:

“If your team member really wants to do something in React and you’re like, hey buddy, sorry we’re actually not working [with] React right now in this project.... I want you to get this experience... Why don’t we find a way to do this at a hack fest or send you to a conference where you could learn this. . . you want to align the company’s goals with the employee’s goals, but sometimes it’s kind of shifting things around and being creative about those solutions. . . . I want developers to be happy.”

Three participants discussed the importance of understanding team members’ goals and providing opportunities to develop skills needed to move to a position they enjoy, or to the next stage of their career.

**3.1.4 Have Sufficient Technical Skills and Knowledge.** Seven discussed how “technical acumen” allowed them to work with a variety of stakeholders. When working with clients, this enabled them “ask meaningful questions and to be perceived by the other parties as being knowledgeable versus being sort of a dope who doesn’t know

what they’re talking about.” On the other hand, “when you’re talking to developers about the product, if you don’t have a fundamental technical understanding of the issues that they face and empathy with them, you’re going to have problems.” All ten participants had served in technical roles prior to their current managerial role, and several felt this was a strength in comparison to peers without that background.

“Learn at least a little bit about the [IT] field ’cause... Let’s say I have a project manager who has a PMP certification [who] is really knowledgeable for the project manager position, but if he is not good at IT or those... terms and the words. He will have a hard time understanding the developers ’cause those folks are always going to talk in a technical language. If you don’t understand that if you’re not good at it.”

Three participants talked about making technical judgments and balancing costs and benefits of potential technical solutions with business goals, and determining whether clients’ wishes are technically feasible.

**3.1.5 Adjust Management Style to Team Members’ Personalities.** Five discussed adjusting their management style to team members’ personality and needs; “you should not manage people the way you want to manage. You should manage people the way that they want to be managed.” Another shared:

“We currently have someone on our team that can interact very well with the three or four of us... but he’s easily distracted and I think blocking him in the basement so that the butterfly flying by his window doesn’t distract him for four hours is probably better. So really in that case it’s more about his own personal [style]. He works so well on the technical side. I’d prefer him not even have to deal with the human side...outside of our team.”

**3.1.6 Appropriately Assign Team Members.** To get the tasks completed efficiently and help the team members grow, four participants mentioned it is important to appropriately assign tasks based on team members’ capability, career goals, skills levels, and preferred working styles.

“The most difficult part of what I do now is... finding the appropriate match of a person to match the technical skill... You know some people are better if you give them a long form of technical tasks. It’s going to take six months. . . at the other end some people require to be spoon fed individual tasks and you must give them six of those a day... Some people can deal with other human beings quite well... and there’s some people that are sharpened and pointy and their personalities and therefore not really a good match to deal with other people. So...constantly juggling what needs to be done with the set of constraints.... that it is probably one of the hardest things I do and also probably one of the most important things because then incorrect choice in one of those goes from something taking five minutes of my day to five hours of my week from trying to soothe personalities on both sides.”



Figure 2: Word cloud of professional skills

### 3.2 Professional Skills

Sixty-six specific professional skills emerged (Figure 2), and were grouped into three main themes (Table 3).

**3.2.1 Communication.** All discussed at least one of 27 communication sub-skills. Three were mentioned by at least three participants.

Five participants mentioned it is important to **tailor language used to the audience**, and to balance technical and non-technical language appropriately. As one explained, “*I talk differently to sales and marketing than I do to engineering managers... you have to assess what people need to know.*” One discussed how they present to clients:

“Understanding what the audience wants to know about the problem.... The audience isn’t interested in or capable of understanding all that depth [required to explain the potential solutions], so you need to be able to present it at a summary level that captures the important pieces, and gives the audience confidence that you actually did it in detail and did them correctly.”

Four participants highlighted the importance of **cross-organizational communication skills**, especially when they were involved in large projects; “*I was also highly involved in guiding a high-level design, which for a project of that size crossed organizational boundaries, which is why a lot of times it did involve people at the management level.*”

Finally, four participants told us that they serve as **translators between technical and non technical stakeholders**, as one described:

“A business needs a technical task and [I have to] kind of be that bridge. I have found that meetings can be wasted if you’re talking in two different languages... and that can cause frustration and... cause a delay in our schedule because a lot of times...the external client will present a need and it’s misunderstood on the technical side and so that development effort is wasted.... You know, everyone knows what their need is, but they may not know how to explain it correctly, and so being able to efficiently communicate with both sides, I think it’s huge in my role.”

**3.2.2 Problem Solving.** Nine participants talked about some of the 17 sub-skills under problem solving, with three mentioned by more than three participants. Four talked about the importance of **analysis and problem identification**:

“[The] first step of problem solving is trying to understand the problem and that usually is the most difficult part of it is figuring out what is the thing that you’re actually trying to do, not how I can start writing software.” Another explained that “if you understand the problem well enough in your designing towards that as an optimal, then you may not be over designing. But if you’re spending a lot of time and you’re driving down the road of optimization towards a solution and you misunderstand the problem, that’s hugely wasted effort.”

Four participants discussed **ill-structured problem solving**, as often problems are not clearly defined and there is not one correct solution:

“Sometimes they may not give you enough information or sometimes may not understand what the entire workflow is.” One described this as “more of an anti-skill is and this is something that happens in computing a lot, not relying on specific knowledge of specific technologies as a crutch for problem solving.”

Three participants mentioned **analyzing solutions and narrowing them down**. One said when problem solving,

“[Try] to not even necessarily design a solution but make a few hypotheticals.... What are the pros and cons of those?... Roads not taken in terms of a solution that may have optimal nonoptimal pieces, but usually there’s some combination of each other so that you may optimize towards.”

**3.2.3 Building Relationship.** Seven participants emphasized the importance of building relationships. Several mentioned that interpersonal skills are important but difficult; “*I think dealing with*

Table 3: Three professional skill categories

| No. | Skills                | Number of participants | Number of excerpts |
|-----|-----------------------|------------------------|--------------------|
| 1   | Communication         | 10                     | 71                 |
| 2   | Problem solving       | 9                      | 50                 |
| 3   | Building relationship | 7                      | 17                 |



Figure 3: Word cloud of dispositions

Table 4: Top eight dispositions

| No. | Dispositions                            | Number of participants | Number of excerpts |
|-----|-----------------------------------------|------------------------|--------------------|
| 1   | Lifelong learning orientation           | 7                      | 13                 |
| 2   | Adaptability/flexibility                | 7                      | 8                  |
| 3   | Self-driven                             | 6                      | 13                 |
| 4   | Self-awareness                          | 4                      | 6                  |
| 5   | Helpful, positive & pleasant            | 4                      | 6                  |
| 6   | Valuing communication and collaboration | 3                      | 5                  |
| 7   | Manager's passion to do technical work  | 3                      | 4                  |
| 8   | Perseverance                            | 3                      | 3                  |

people is far more difficult than dealing with computers.” Six participants pointed out the importance of building trust with all partners and stakeholders.

“One key skill set is working on my relationships, building the trust, when leading or managing others...[It is important] from a management standpoint to make yourself available to those that you lead or manage, because that builds trust. And that builds those communication lines that are critical to the success of the team....and it's little moments like that where people can understand that they're being heard and that they're feeling respected and that they're contributing...equal parts to the solution.”

### 3.3 Dispositions

Thirty-eight dispositions were identified, as shown in the word cloud in Figure 3. Eight dispositions mentioned by at least three participants are listed in Table 4. These are discussed in the sections below.

**3.3.1 Lifelong Learning Orientation.** A pro-lifelong learning orientation rose to the top of the dispositions. While self-directed learning might be in aid of a specific project, for managers it more frequently had the goal of keeping up to date with technology. As one stated, “We are in IT. You know, the field is changing every day. So if you want to stay on top of it, just learn everything.” This allowed them to communicate with and manage technical staff and assess the feasibility of technical solutions. Participants were not

only willing but passionate about engaging in lifelong learning. They used a variety of resources for learning (e.g., in-person or on-line courses, trade journals, blogs), and described a common habit of creating projects for the sole purpose of learning technical skills.

“There was a passion so I would go home and find some project so it might be like installing a new Linux distribution... Or maybe I'll just like hey, I really want to do this new website or project that I would think would be fun and I would just go learn something just to do something fun.”

**3.3.2 Adaptability/Flexibility.** Being flexible and able to adapt to the situation was seen as crucial. As one explained, “it's the people that can adapt quickly that are going to be able to jump into that corporate environment and really hit the ground running.” They emphasized that someone in this field needs to be “open to anything that's thrown at him” and to be sufficiently flexible in “understanding when you're going down a path that's not going to lead to success and getting off that path and finding another way quickly.”

**3.3.3 Self-driven.** Participants discussed the need to be self-motivated, even when they are not intrinsically interested in a task. Some spoke of this in terms of work ethic and emphasized the need to be “willing to put extra time in going above and beyond [and] those people are usually very successful. Just because you know you don't want someone who says ‘well that's not my job. I'm not doing it.’”

**3.3.4 Self-awareness.** Participants discussed the need for themselves and their team-members to be self-aware. “Having enough awareness and introspection to know what your strengths are and what your weaknesses are, and how to leverage those strengths and weaknesses relative to your team, whether they’re at an engineering level or a managerial level.” Self-awareness is beneficial in many ways “It’s a way of examining yourself, understanding how you learn, how you assimilate information, how you interact with others...how you problem [solve].”

**3.3.5 Helpful, Positive & Pleasant.** Participants stressed that their attitude impacts others. “People that are willing to...help others, lend a listening ear, to be there when there’s hard times or there’s problems to solve. Those are always very good qualities.”

**3.3.6 Valuing Communication and Collaboration.** Being a team player and “collaborat[ing] in a healthy way with other people” was a crucial disposition. “If you can’t work with other people, you limit yourself severely and in a professional environment.”

**3.3.7 Manager’s Passion to do Technical Work.** Three participants specifically mentioned their own passion for continuing to do technical work, while others at least implied similar feelings. “I never really stepped aside from actually still writing code, even when I was managing people.” In fact, several give themselves small projects to work on. However, they recognized that they need to allow their team members to show their expertise.

“You can still be a smart person in the room, but you shouldn’t be the smartest person in the room about the problem...You should give up fun stuff. And give that to your team. You shouldn’t be in a critical path... [You need to learn] how to give up those fun pieces of development.”

**3.3.8 Perseverance.** Three individuals explicitly discussed the importance of perseverance or “grit”, although this disposition also implicitly underlies many stories shared across participants. One described in vivid terms:

“When I was a CTO. . . I ran into this problem that I had no clue how to solve and I remember lying on the ground and just lying on the ground miserable because there was no one else ..I just keep beating my head against the wall trying to figure out how to solve this particular issue and I had to find ways to stay motivated to solve that... problem.”

## 4 DISCUSSION & CONCLUSION

The results of this study align with the IT2017 [14] and CC2020 [2] reports’ emphasis on competencies such as lifelong learning, professional development, ethics/responsibility, adaptability, interpersonal skills, problem solving, and advocacy; and ABET computing accreditation criteria “principles and practices of IT project management” [1].

This study found that six core managerial skills each of which involve interactions with people and decision making. Although new graduates may not require these skills on their first job, one participant suggested that programs add course activities to guide students to consider potential career paths.

“You need to be positioning yourself fairly early in your career to get to where you want to be or you won’t be able to get there. So if ...you recognize that you really prefer to move towards management, then you need to think about early on ‘what do I need to do to make that happen and do it?’”

Discussion of possible career paths can be integrated throughout a degree program (aligning with IT2017’s competency sub-domain *employability skills and careers in IT* [14].) Although not all computing professionals wish to enter management, within a few years of their career most will begin mentoring and may be involved in interviewing new applicants. Many professionals need to interface with users, participate in discussions about user requirements, and prioritize their own work, and would benefit from acquiring IT project management skills during their undergraduate work.

Managers interviewed highlighted 66 professional skills and 38 dispositions. These types of competencies have been shown to be important not only to managers, but also to professionals across computing disciplines and across industries [7, 8, 17]. Therefore, in today’s world, purposeful development of professional skills and dispositions cannot be ignored.

A competency-based approach to education would allow competencies such as those identified in this study to be explicitly included in curricular mapping. Methods such as spiral curriculum planning would ensure that competencies are taught and addressed in multiple points throughout a program, which is essential for developing professional skills and dispositions. Furthermore, a move away from the traditional lecture-lab-exam instructional model towards experiential learning (as recommended by the ABET IT criteria’s curricular requirements [1]) would support the development of managerial and professional skills, while experiential learning may be paired with enculturation and reflection to support the development of dispositions. Assessment of projects, portfolios of curated artifacts taken from realistic experiences, reflection activities, and self-and-peer assessment are particularly appropriate fostering and assessing dispositions. Badges, portfolios, or other methods that track attainment of competencies across a program are particularly useful in competency-based education.

Managerial skills development can be fostered through encouraging students to take lead roles in group projects. Students can be prepared for internships by helping them to select opportunities that align with their goals, and by guiding them to observe and reflect on organizational practices during their experience. Programs with structured internship or co-op experiences may also help place students and co-design experiences with supervisors to ensure that students gain meaningful professional skills and dispositions. Computing professionals and managers can also be involved as special guests, judges for project presentations, or mentors to help students connect what they learn to what they will do in the future. As this paper demonstrates, mentors and other professionals have much to share and programs would benefit from their substantive involvement in curricular decisions.

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## REFERENCES

- [1] ABET (2022). ABET Criterial for Accrediting Computing Programs, 2022 – 2023. <https://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-computing-programs-2022-2023/>
- [2] A. Clear, A. Parrish, P. Ciancarini, S. Frezza, J. Gal-Ezer, J. Impagliazzo, A. Pears, S. Takada, H. Topi, G. van der Veer, A. Vichare, L. Waguespack, P. Wang, and M. Zhang. 2020. Computing Curricula 2020 (CC2020): Paradigms for Future Computing Curricula.
- [3] Barry M. Lunt, Joseph J. Ekstrom, Sandra Gorka, Gregory Hislop, Reza Kamali, Eydie Lawson, Richard LeBlanc, Jacob Miller, and Han Reichgelt. 2008. Curriculum Guidelines for Undergraduate Degree Programs in Information Technology. Technical Report. Association for Computing.
- [4] Capretz, L. F., & Ahmed, F. (2010). Why do we need personality diversity in software engineering? *Software Engineering Notes*, 35(2), 1–11.
- [5] Carracedo A., & Saiz, C. (2011). Skills and dispositions of critical thinking: Are they sufficient? *Anales de psicologia*, 27(1), 202-209.
- [6] Dzwigol, H., Dzwigol-Barosz, M., Miskiewicz, R., & Kwilinski, A. (2020). Manager competency assessment model in the conditions of industry 4.0. *Entrepreneurship and Sustainability Issues*, 7(4), 2630–2644. [https://doi.org/10.9770/jesi.2020.7.4\(5\)](https://doi.org/10.9770/jesi.2020.7.4(5))
- [7] Frezza, S., & Adams, S. (2021). Bridging professionalism: Dispositions as means for relating competency across disciplines. *IEEE Frontiers in Education Conference Proceedings*, pp. 1-5. doi: 10.1109/FIE44824.2020.9274058
- [8] Hart Research Associates. (2018, July). Fulfilling the American dream: Liberal education and the future of work. Washington, DC: Author. Retrieved from <https://www.aacu.org/sites/default/files/files/LEAP/2018EmployerResearchReport.pdf>
- [9] Indeed Editorial Team (2021). 84 management job titles to know. <https://www.indeed.com/career-advice/finding-a-job/management-job-titles>
- [10] Janz, K., & Honken, R. (2013). Personality inventories and cognitive frames: understanding the balance in managing and leading IT organizations. *Proceedings of the 41st Annual ACM SIGUCCS Conference on User Services*, 143–150. <https://doi.org/10.1145/2504776.2504798>
- [11] Katz, L. G. (1993). Dispositions as Educational Goals. *ERIC Digest*.
- [12] Lee, H., Park, J., & Lee, J. (2013). Role of leadership competencies and team social capital in IT services. *The Journal of Computer Information Systems*, 53(4), 1–11. <https://doi.org/10.1080/08874417.2013.11645645>
- [13] Lincoln, Y., & Guba, E. (1985). *Naturalistic inquiry*. Newbury Park, CA: Sage Publications.
- [14] M. Sabin, H. Alrumaih, J. Impagliazzo, B. Lunt, M. Zhang, B. Byers, W. Newhouse, B. Paterson, S. Peltserger, C. Tang, G. van der Veer, and B. Viola. 2017. *Information Technology Curricula 2017*. Technical Report. ACM/IEEE Computer Society, <https://dl.acm.org/doi/pdf/10.1145/3173161>.
- [15] Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic Analysis: Striving to Meet the Trustworthiness Criteria. *International Journal of Qualitative Methods*, 16(1), 1–13. <https://doi.org/10.1177/1609406917733847>
- [16] Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., & Hoagwood, K. (2015). Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Adm. Policy Ment. Health*, 42(5), 533–544. <https://doi.org/10.1007/s10488-013-0528-y>.
- [17] Shet, S. V., & Pereira, V. (2021). Proposed managerial competencies for Industry 4.0 – Implications for social sustainability. *Technological Forecasting & Social Change*, 173, 121080–. <https://doi.org/10.1016/j.techfore.2021.121080>
- [18] M. Spreen. 1992. Race populations, hidden populations, and link-tracing designs: What and why? *Bullitin de Methodologie Sociologique*, 36, 34–58.
- [19] Varona, D., Capretz, L. F., Piñero, Y., & Raza, A. (2012). Evolution of software engineers' personality profile. *Software Engineering Notes*, 37(1).