

# Actions Recent Engineering Graduates Undertake to Integrate into the Workplace – A Case Study from the Aerospace Industry\*

BENJAMIN AHN<sup>1\*\*</sup>, YUN DONG<sup>2\*\*</sup> and SECIL AKINCI-CEYLAN<sup>3</sup>

<sup>1</sup> The Ohio State University, Columbus, OH, 43210, USA. E-mail: ahn.383@osu.edu

<sup>2</sup> Waubonsee Community College, Sugar Grove, IL, 60554, USA. E-mail: ydong@waubonsee.edu

<sup>3</sup> Iowa State University, Ames, IA, 50011, USA. E-mail: secil@iastate.edu

This study extends the literature on organizational socialization by examining newly-hired engineers' proactive actions to integrate into the workplace, relating them to the four primary socialization task domains – task mastery, role clarification, acculturation, and social integration. The study conducts semi-structured interviews with 26 newly-hired engineers in aerospace companies. The results identify 16 proactive actions of newly-hired engineers during their socialization period. The most crucial actions during the onboarding period are interacting with coworkers, using available resources and tutorials, participating in training opportunities, learning through hands-on experience, seeking opportunities to learn and solve problems independently, and possessing self-belief to meet commitments. The study's findings provide valuable practical implications for engineering students, newly-hired engineers, engineering managers and organizations, and engineering educators concerning the use of specific actions to improve newly-hired engineers' socialization period.

**Keywords:** workplace socialization; workforce development; newly-hired engineers; proactive actions; aerospace engineering

## 1. Introduction

Despite the wealth of knowledge and skills acquired during their undergraduate training, newly-hired engineers must learn how to approach their roles and responsibilities at work, build relationships with coworkers, and internalize organizations' culture and norms to contribute to their organization effectively. To this end, they need to socialize in their workplace. During this transition, newly-hired engineers can engage in proactive actions and processes (i.e., a series of actions or sequences of interrelated proactive measures) to deal with their tasks, coworkers, and organizations.

This study explores the proactive actions of newly-hired engineers by interviewing 26 engineers in the aerospace and defense (A&D) industry in the U.S. The interviewed participants are full-time engineers with less than three years of work experience. The study identifies 16 proactive actions engineers engage in to achieve task mastery, role clarification, acculturation, and social integration. The proposed analysis can inform engineering students and recently-hired engineers about the typical actions performed during the onboarding process. Further, engineering managers can learn about newly-hired engineers' actions and experiences, potentially improving their onboarding programs. Similarly, the study's results may help

engineering educators create education programs to better prepare their students for transitioning into the engineering workforce.

The remainder of this paper is organized as follows. Section 2 reviews the socialization literature and presents the research objectives. Section 3 describes the research data and method, Section 4 presents the study's findings, Section 5 explores the significance of the study's results, and Section 6 discusses the implications for stakeholders. Finally, Sections 7 and 8 conclude, discussing the study's limitations and future research directions.

## 2. Literature Review

### 2.1 Workplace Socialization

Newly-hired employees socialize in the new workplace by engaging in actions that improve their fit with the work environment [1–4, 5, pp. 67–130, 6]. Previous studies suggest that they must succeed in four primary task domains during the socialization period: task mastery, role clarification, acculturation, and social integration [2, 7, pp. 117–139, 8]. Task mastery involves learning how to perform one's roles, as new employees must proactively acquire the knowledge and skills necessary to fulfill their roles. Role clarification implies understanding one's roles and responsibilities. New employees must also recognize the behaviors others expect of them. Acculturation is the process of learning about and adjusting to a culture. New employees must

\*\* Equal Contribution.

discover their workplaces' norms, values, and approved behaviors and attitudes. Social integration involves developing relationships with others. Hence, new employees must seek opportunities to interact with coworkers and create friendships and social support networks. New employees must accomplish these four socialization task domains to adjust to their new environment, improve their engagement and commitment to their organizations, and earn the right to assume their roles and be accepted by their peers [9, pp. 34–47, 10].

### *2.2 Importance of Early Socialization for Engineers*

Early socialization is critical for newcomers. Research consistently shows that newcomers' initial experiences often influence their subsequent learning, performance, attitudes, job satisfaction, and commitment to the organization [11–16].

Newly-graduated engineers often find early socialization challenging due to their misconceptions about engineering and what engineers do. For example, students typically view engineers as mediators of science, math, and technology to society and fail to understand the profession's service role, as characterized by the National Academy of Engineering [17]. In addition, newly-graduated engineers typically have inflated notions of their professional status because their engineering identity emphasizes academic ability instead of participation and success in professional engineering roles [18]. In other words, they tend to think that high performance in university courses automatically assigns them a high ranking in the engineering profession. Such misconceptions can cause new graduates to experience shock, confusion, and frustration when they enter the workforce [19].

Furthermore, university engineering education training often occurs in a formal, well-structured, and prescribed learning environment. In contrast, engineering companies present a far less structured work environment, challenging newly-graduated engineers [19, 20]. Those who fail to socialize early in their engineering careers may be unable to fit properly into their environment and often seek other occupations [21]. Therefore, new engineers must socialize in their workplaces as soon as possible to achieve successful professional lives.

### *2.3 Prior Research on the Socialization of New Engineers*

Previous studies on socialization have generally discerned two aspects of the socialization process: individual-driven actions and processes (also known as proactive behaviors) and organization-driven tactics to facilitate newcomers' socialization. Although both factors are crucial, this study

focuses on the former aspect for the following reasons: (1) previous studies show the importance of new engineers' actions and processes in achieving work-related outcomes (e.g., [22, 23]), (2) proactive actions and processes may accelerate and optimize socialization (e.g., [12, 24–27]), and (3) engineering managers and supervisors expect newcomers to demonstrate proactive actions and processes to quickly adapt to the job (e.g., [19, 28, 29]).

Despite the importance of individual actions and processes during socialization, very few studies have examined these aspects in newly-hired engineers in the U.S. context. These studies fall into one of two categories.

The first category examines newly-hired engineers' behaviors during socialization in terms of outcomes (e.g., performance, learning, job satisfaction, commitment, and retention). For example, Ashforth et al. addressed 150 engineering (and business) graduates from a large Southwestern state university during their first few months as full-time employees [11]. They examined how individual-driven actions and processes affected recent hires' outcomes. These actions and processes comprised information seeking, feedback seeking, general socializing, modifying one's roles and others' expectations to better align with one's skills, and having optimistic views. They surveyed participants three times during the first seven months of their full-time jobs. Their path analysis showed that proactive actions and processes correlated with newcomers' learning and were positively associated with performance and job satisfaction. In addition, proactive actions and procedures positively correlated with role innovation (questioning and challenging the status quo of roles) and commitment.

Another study belonging to this category is the meta-analysis by Bauer et al. [12]. They examined the links between newcomers' proactive information-seeking behaviors and organizations' socialization tactics and various newcomers' outcomes at work (e.g., performance, job satisfaction, commitment, intentions to remain, and turnover). In addition, they addressed newcomers' role clarity, self-efficacy, and social acceptance. They found that information-seeking behavior was essential for attaining role clarity and social acceptance. In addition, role clarity correlated with all outcomes except turnover, self-efficacy was related to all outcomes except job satisfaction and commitment, and social acceptance correlated with all outcomes.

Although these studies and others highlight the importance of new engineers' socialization actions and processes and contribute to understanding their association with outcomes at work, they do not provide in-depth accounts of new engineers' actions and processes during socialization. The

survey items used in these studies provide a limited picture of the complex and interrelated actions and processes that new engineers employ during socialization. Furthermore, the proposed surveys did not specifically address engineers. For example, Ashforth et al. [11] used the Ashford and Black scale [24], based on data collected from recently-hired practicing managers with business school degrees. It is, therefore, reasonable to question whether these surveys accurately and comprehensively portray the actions and processes of new engineers during workplace socialization.

The second category of studies addressing actions and processes during socialization examines (1) how newly-hired engineers learn job-related tasks, social norms, skills, and other factors that their employers deem critical and (2) the expectations and experiences of newly-hired engineers. For example, Korte investigated how 30 newly-hired engineers (a combination of recently graduated engineers from undergraduate programs and professionally experienced engineers) at a large manufacturing company learned job-related tasks and the organization's social norms [13]. The study found that (1) the primary driver of socialization was building relationships with members of the workgroups (both coworkers and managers), and (2) the primary context for socialization was the workgroup. This study reported that new engineers who formed high-quality relationships with coworkers and managers received valuable support and had highly satisfying learning experiences at work. Another study by Korte and colleagues examined 41 newly-hired engineers' and 15 managers' socialization experiences and expectations from three U.S.-based manufacturing and transportation organizations [19]. Their findings showed that newly-hired engineers were surprised about and frustrated with the unstructured way in which they had to learn their jobs. They also reported receiving informal, unstructured training and being requested to learn through self-directed trial and error. Managers expected newly-hired engineers to learn independently, and some intentionally limited their guidance, displaying "throw'em into the fire" or "sink or swim" attitudes. Some managers admitted that their company training programs were inadequate for new engineers and reported not having enough time to help newly-hired engineers familiarize themselves with the work environment.

Anderson and colleagues explored engineering work and engineer identity using an ethnographic approach and identified various critical skills for socialization [30]. They interviewed engineers and engineering managers working in six Midwestern firms varying in size and industry sector. They found

that the most critical skills for engineers were communication (e.g., listening to clients and asking questions) and coordination (e.g., coordinating team interactions and team learning processes). They also showed that incoming engineers lacking these skills often faced challenges at work. Another study by Scott and Yates interviewed high-performing graduates (as determined by supervisors' evaluations) and found that emotional intelligence was vital to attaining a thriving professional practice in engineering within the first few years [31].

This second category of studies provides crucial insights into possible actions and processes associated with learning job-related tasks and essential factors during socialization (e.g., high-quality relationships between newcomers and others in the organization). These studies and others [e.g., 42] also reveal the challenges and frustrations engineers experience during socialization while managing companies' expectations that they will learn on their own, faced with the inadequacy of many companies' training programs. These studies, however, do not adequately describe effective newcomer actions during socialization (e.g., how to build high-quality relationships with coworkers and managers and acquire the required skills and knowledge). Furthermore, these studies only focus on one or two socialization task domains, addressing narrowly focused actions and processes or exploring them in a fragmented fashion. Further research is needed to clarify how new engineers' actions and processes help them succeed in all four socialization task domains: task mastery, role clarification, social integration, and acculturation to the organization. To address this research gap, this study investigates the actions and processes that newly-hired engineers hired by an aerospace company engage in during workplace socialization to succeed in the four socialization task domains of task mastery, role clarification, acculturation, and social integration.

### 3. Data and Method

#### 3.1 Research Design and Context

This study employed a multiple-case research design, a qualitative approach, to describe and analyze multiple cases from real-world phenomena [32–34]. Multiple-case research design is appropriate when (1) phenomena cannot be adequately explained or organized into an a priori specification of constructs (or an existing theory), but the constructs provide crucial insights into what to measure [33]. This study addressed socialization actions and processes as phenomena, and constructs are the four socialization task domains; (2) qualitative data offer an in-depth understanding of complex social

phenomena in real-world contexts in which researchers have no control over events [34]; (3) a study addresses “how” and “why” questions [35].

Multiple-case research designs compare, contrast, extend, and eliminate patterns of phenomena within and across different cases [35]. Creswell defines cases as “multiple bounded systems,” which, in this study, will be newly-hired engineers from four different aerospace companies [32]. A research design with multiple participants generates more accurate and robust findings than a research design addressing a single participant because it allows broader explorations of the relationships between phenomena [34].

3.2 Data Collection

This study recruited 26 engineers from the four largest A&D organizations in the U.S. Table 1 presents the participants’ demographic information. Semi-structured interviews were conducted with each participant in the Fall of 2019 and

Spring of 2020. All participants had engineering or science degrees from U.S. universities and worked for less than three years as full-time engineers in their respective A&D organizations. The interview questions inquired about specific actions and processes study participants used to accomplish the four socialization task domains. The task domains were individually described, and participants were asked whether they achieved them and, if so, what actions and processes they undertook to accomplish them. They were encouraged to share specific examples of recent experiences and their outcomes.

Twenty-five interviews were conducted via an online videoconferencing tool and one in person. Each interview lasted approximately 60 minutes, and the participants received an online gift card (\$ 99.99 U.S. dollars) following the interview as compensation for participating. All the interviews were audio-recorded and transcribed verbatim by external transcriptionists.

Table 1. Participants’ Demographic Information

Participant	Race/Ethnicity	Gender	Undergraduate major	Months working	Job title
1	White	Male	Computer Science	16	Software Engineer Associate
2	White	Male	Aerospace Engineering	10	Mechanical Engineer I
3	White	Female	Computer Engineering	16	Software Engineer
4	White	Male	Aerospace Engineering	7	Manufacturing Engineer
5	White	Male	Industrial Engineering	3	Rotational Engineer
6	White	Male	Aerospace Engineering	4	Aerospace Engineer III
7	White	Male	Aerospace Engineering	15	Project Engineer
8	White	Female	Aerospace Engineering	9	Mission Systems Engineer
9	White	Female	Aerospace Engineering Sciences	3	Systems Integration/Test Engineering Associate
10	White	Male	Aerospace Engineering	6	Propeller Design Engineer
11	White	Female	Aerospace Engineering	17	NPD Propulsion Engineer
12	White	Female	Industrial Engineering	16	Industrial Engineer
13	White	Female	Aerospace Engineering	16	Software Engineer
14	White	Female	Industrial Engineering	4	Industrial Engineer
15	*HLS	Female	Mechanical Engineering	27	Manufacturing Engineer
16	White	Male	Aerospace Engineering	9	Systems Engineer Associate
17	White	Male	Aerospace Engineering	16	Aerodynamics Configuration Engineer
18	White	Female	Industrial Engineering	17	Supplier Quality Engineer
19	Asian	Female	Industrial Engineering	3	Senior Project Engineer, Additive Manufacturing-Supply Chain
20	White	Male	Mechanical Engineering	22	Manufacturing Engineer
21	White	Male	Aerospace Engineering	5	Spacecraft Electronics Manufacturing Engineer
22	White	Male	Mechanical Engineering	17	Manufacturing Engineer
23	White	Male	Aerospace Engineering	4	Systems Engineer Associate
24	White	Female	Mechanical Engineering	13	Quality Engineer
25	*HLS	Male	Mechanical Engineering	10	Quality Engineer
26	White	Male	Aerospace Engineering	11	Project Engineer

\*HLS: Hispanic, Latino, or Spanish Origin.

### 3.3 Data Analysis

The research team, consisting of engineering education researchers, graduate research assistants, and undergraduate students, analyzed the interview transcripts following the procedure proposed by Eisenhardt [33] and Miles and Huberman [36]. The study first developed a codebook to analyze all transcripts. It then applied the codebook to all transcripts to build evidence of proactive actions.

The codebook development comprised three phases: (1) the selection of six representative transcripts, (2) the open coding of descriptive statements in the transcripts to develop codes and categories, and (3) the comparison of the codes and categories to conceptually organize them by research objective into a codebook. The research team carefully read all 26 transcripts to select the representative items. It reached a consensus on six items containing rich and unique data, representing a demographically diverse set of engineers. During the open coding phase, the six selected transcripts were reread, and descriptive preliminary codes representing a statement or phrase in each transcript were generated. After revising the codes and eliminating duplicate codes, the study sorted the codes into categories. The same open coding process was applied to each selected transcript. Next, the study compared the code and category definitions from each transcript to merge or separate

codes and categories and identify “saturated” categories (i.e., categories that were not affected by adding new codes or statements). This phase reduced the interview data to codes and categories addressing the research objective. Finally, codes and categories were organized by research objective into a codebook.

The next phase applied the codebook to all interview transcripts to build new evidence. Using the codebook, the study performed a cross-case analysis of the remaining 20 transcripts. The initial stage of the research refined the definitions of codes and categories in the codebook, revealing codes and categories not presented in the selected representative transcripts. The study assigned codes and categories from the codebook to responses in the transcripts, which helped build evidence for preliminary findings. The preliminary results were constantly verified and compared with supporting evidence.

## 4. Results

This study identifies 16 proactive actions from participants’ responses. The proactive actions and the definitions derived from the interview responses are presented below. Table 2 shows the proactive actions in the task mastery, role identification, social integration, and acculturation domains.

**Table 2.** Overview of Newly-Hired Engineers’ Proactive Actions

Actions	Task Mastery	Role Clarification	Social Integration	Acculturation
Impacting all domains				
Interact with coworkers	✓	✓	✓	✓
Shadow or observe coworkers	✓	✓	✓	✓
Attend meetings	✓	✓	✓	✓
Attend classes	✓	✓	✓	✓
Impacting 2 or 3 domains				
Utilize resources	✓	✓		✓
Create resources	✓	✓		✓
Undertake practical tasks	✓	✓		
Offer to help others		✓	✓	
Possess positive work ethics	✓		✓	
Attend social gatherings			✓	✓
Consider coworkers’ point of view			✓	✓
Have a strong self-belief			✓	✓
Impacting one domain				
Attempt task independently		✓		
Suggest team establishment or modification		✓		
Self-study for self-improvement	✓			
Utilize prior network connection			✓	

Some actions achieve all or multiple domains, while others only achieve one. The remainder of this section will describe in detail the actions and the socialization task domains they belong to (in parentheses).

#### *4.1 Newly-Hired Engineers' Actions Impacting All Domains*

1. Interact with coworkers (all domains): Newly-hired engineers actively initiate interactions with members of the organizations, such as coworkers, mentors, team leaders or managers, and other coworkers in the organizations who previously held their same or similar positions. Most interactions initiated by the newly-hired engineers involve asking questions on completing job-related responsibilities and requesting assistance for acquiring job-required knowledge (e.g., how to run a test, the procedure for documenting a test procedure, where to find additional resources, and where the documents are stored). Newly-hired engineers also initiate conversations with workgroup members about non-work-related topics to strengthen their relationships. For instance, newly-hired engineers introduce themselves and share their backgrounds and experiences with their colleagues.

2. Shadow or observe coworkers (all domains): Newly-hired engineers keenly shadow or observe other organization members. They ask their coworkers whether they may sit next to them and watch them work. They shadow or observe their colleagues for a couple of weeks. While doing so, newly-hired engineers acknowledge how their coworkers perform their responsibilities, behave, and interact with others. By observing and later imitating their coworkers, newly-hired engineers better complete their job responsibilities and understand their duties in the organization. Moreover, when their coworkers meet new people or those in a leadership position, newly-hired engineers first observe how their colleagues interact and then slowly open themselves up and join the conversations. Keen observation helps newly-hired engineers understand the personality of their colleagues and the organization's culture.

3. Attend meetings (all domains): Newly-hired engineers attend meetings held by their workgroups or organizations, such as customer, "all-hands-on-deck," regularly scheduled workgroups, and annual organization-level meetings. These activities allow newly-hired engineers to understand better how their work aligns with the organization, helping them perform their job responsibilities. The meetings also enable newly-hired engineers to learn how to interact with and lead a group of people. In the meetings, newly-hired engineers observe first-hand how their colleagues and mentors behave (e.g., how

they facilitate the meetings or ask questions). Observation teaches them how to perform and behave in similar settings. Further, during these meetings, newcomers observe the coworkers' behaviors and interactions (e.g., who supports the points made and who "stirs up the pot"), which is critical for understanding the people and the culture of the workgroup and the organization. Attending meetings also helps newcomers interact with those they would typically not interact with often or meet.

4. Attend classes (all domains): Newly-hired engineers attend organization-led courses to acquire specific engineering knowledge (e.g., lean manufacturing and supply chain quality). These classes help new engineers gain basic and essential engineering knowledge and learn how to use it in their organizations. This awareness, in return, allows engineers to perform their roles and responsibilities. Some newly-hired engineers use these classes to build future career advancement opportunities. These courses also teach newly-hired engineers about the organization's culture, helping them discern acceptable and unacceptable behaviors in their organizations when completing work tasks. Finally, by attending these classes, newly-hired engineers meet other people in the organization whom they would typically not interact with or communicate with. Newly-hired engineers use the contents from these classes to start conversations with others and obtain further information about these contents and their application in the company. These in- and after-class interactions support newly-hired engineers in developing new relationships with other organization members.

#### *4.2 Newly-Hired Engineers' Actions Impacting Two or Three Domains*

5. Utilize resources (role clarification, task mastery, and acculturation): Newly-hired engineers proactively seek and utilize technical and non-technical resources. Their organizations or mentors provide resources, such as technical manuals and internal organizational documents, helping them acquire the necessary knowledge and know-how to complete their tasks. Further, organization documents, which include the mission statement and the organization's purpose, help newly-hired engineers better understand their and the organization's responsibilities. Finally, this action requires newly-hired engineers to read through periodic internal newsletters, including the CEO's perspective and other relevant, newsworthy items related to the organization and industry.

6. Create resources (role clarification, task mastery, and acculturation): Newly-hired engineers create or update existing organization resources when they find the current resources inadequate

or outdated. Engineers need to constantly acquire or update their skills. However, sometimes their organizations do not have nor update the necessary resources (e.g., procedural documentation). Therefore, while working on various tasks, learning new skills, or simply perceiving the workplace atmosphere, newly-hired engineers either revise the outdated resources or create new ones, making them available for other personnel in the organization.

7. Undertake practical tasks (role clarification and task mastery): Newly-hired engineers master their tasks and understand their responsibilities by completing practical tasks in the field. Newly-hired engineers recognize that “trial and error” or “repeating the tasks over and over” may not be the most efficient approach. However, they consider participating in tasks with their workgroup necessary for achieving role clarity and task mastery.

8. Offer to help others (role clarification and social integration): Newly-hired engineers offer to help coworkers with their tasks. This action typically accomplishes two goals: better understanding their roles and responsibilities by assisting others and improving their relationships with coworkers. Newly-hired engineers believe that offering help to coworkers may benefit both themselves and the workgroup, leading to better organizational outputs.

9. Possess positive work ethics (task mastery and social integration): Newly-hired engineers work hard, produce solid outcomes, and keep an upbeat attitude as they perform their tasks. This action supports them in mastering the required knowledge and skills. Further, this action leads to newly-hired employees being recognized by their colleagues as trustworthy and hardworking engineers and helps them build positive working relationships.

10. Attend social gatherings (acculturation and social integration): Newly-hired engineers attend various social gatherings to meet new coworkers and build relationships. Social gatherings they attend include guest speaker seminars, weekly lunches, and recreational events (e.g., sports events and zoos). These gatherings are organized by their managers or coworkers, or newly-hired engineers organize them.

11. Consider coworkers’ point of view (acculturation and social integration): As newly-hired engineers observe their colleagues in team settings and work environments, they understand coworkers’ perspectives and working habits. They attempt to understand coworkers’ points of view and question why their coworkers complete a specific task or behave the way they do. Some newly-hired engineers recognize that some coworkers’ actions may result from their age, experience, and possibly the organization’s culture. These considerations help

them understand the organization’s culture, providing insights into how to interact and communicate with colleagues.

12. Have a strong self-belief (acculturation and social integration): Newly-hired engineers remind themselves that they are valuable members of their team/organization and that their opinions matter, acknowledging the importance of expressing their views. Further, they discuss the importance of being themselves in front of others and not worrying about being judged. This action boosts their confidence to interact with colleagues and contribute to the company’s culture.

#### 4.3 Actions Impacting One Domain

13. Attempt task independently (role clarification): Newly-hired engineers understand their roles and responsibilities by completing tasks independently. The main difference between this action and the *Undertake Practical Tasks* action is that, in this case, newly-hired engineers independently solve problems or complete tasks without help or support from coworkers. During this process, they often use resources as a guide (i.e., *Utilize Resource* action).

14. Suggest team establishment or modification (role clarification): Newly-hired engineers suggest establishing a new team or modifying an existing team to procure the necessary support and expertise to complete tasks (e.g., troubleshooting problems). While working on their tasks, they recognize their inability to accomplish some tasks without additional support and expertise. They understand what they can and cannot accomplish on their own. Therefore, newly-hired engineers establish a new team of personnel with the necessary expertise and skills. They understand their colleagues’ expertise and bring them together.

15. Self-study for self-improvement (task mastery): Newly-hired engineers self-teach the skills and knowledge required to perform their job responsibilities. They deploy time and effort during on- and off-workdays to learn the necessary skills and knowledge. Newly-hired engineers recognize they lack the knowledge to fully comprehend their tasks’ background. Therefore, they need to reflect on their own to obtain knowledge.

16. Utilize prior network connection (social integration): Newly-hired engineers reach out to their previous connections in the organization, such as university alums or friends, to learn about various events and volunteer activities. Leaning on to their university alums or friends who have been in the organization for longer or in different positions helps newly-hired engineers find venues for social interactions with others in the organization. The critical difference between this action and the *Interact with Coworkers* action is reaching out to a

network of people newly-hired engineers knew before joining the organization.

#### 4.4 Common Patterns Among the Identified Practice Actions

Five key underlying patterns emerge from the 16 identified actions. Although these patterns result from specific aerospace organizations and their newly-hired engineers, they clarify how engineers may typically behave during their onboarding period.

- Interact with their coworkers. Eight actions (e.g., *Interact with Coworkers*, *Shadow or Observe Coworkers*, *Attend Meetings*, *Offer to Help Others*, *Attend Social Gatherings*, *Consider Coworkers' Point of View*, *Suggest Team Establishment/Modification*, and *Utilize Prior Network Connections*) involve some forms of interaction between newly-hired engineers and coworkers. Interactions allow newly-hired engineers to obtain information about their work, responsibilities, and coworkers. Such interactions happen both at work and in social gatherings. This key action highlights the importance of newly-hired engineers opening themselves to and interacting with others.
- Use available resources and tutorials and participate in training opportunities. Newly-hired engineers seek and use resources created by their organizations, which are crucial for acquiring new knowledge and learning the organizational procedure to perform their responsibilities. In addition, various resources are created and updated by their colleagues. Newly-hired engineers find them valuable, reliable, and directly applicable to their responsibilities. Sometimes, newly-hired engineers update the available resources or create new sets of resources for themselves and others. They rely heavily on these resources, highlighting the importance of organizations having well-documented and updated resources for their newly-hired engineers. Such documents facilitate knowledge transfer between engineers.
- Learn through hands-on experience. Newly-hired engineers emphasize the importance of first-hand experience in completing their tasks. Field experience may provide them with the knowledge, skills, and practice to perform the same and related tasks. They also mention that helping others with their tasks further enhances their skills and helps them understand how their roles integrate into the team's goals. Hence, they purposely seek opportunities to assist their coworkers.
- Seek opportunities to independently learn and solve problems. Newly-hired engineers state that

they desire independence in their working and learning processes. Before asking for help or advice from coworkers, they work on their own to find answers. They complete tasks and learn independently, taking the time to think about the problems they encounter and find autonomous solutions. This attitude helps them obtain a deeper understanding of their roles and master significant knowledge and skills.

- Possess self-belief and meet commitments. The newly-hired engineers remind themselves that they belong in their organizations and contribute to their goals by actively participating in their roles. Although not directly mentioned by participants, newly-hired engineers may experience a sense of impostor syndrome, as the majority are recent college graduates and lack experience and knowledge. However, the study's participants believe they may contribute to the organization by fully engaging in their responsibilities and producing quality work. These attributes spread a positive image among their coworkers and help newly-hired engineers gain their trust and respect.

## 5. Discussion

### 5.1 Comparison between the Previously Identified Behaviors and Newly Identified Proactive Actions

Several identified proactive actions aligned with proactive behaviors from previous studies. This study showed that interaction with coworkers played a significant role in newly-hired engineers' socialization. Eight actions that emerged in the interviews consisted of some forms of interaction. This finding is consistent with the results of Korte, who has shown that the relationship between newly-hired engineers and coworkers is the primary driver of the onboarding period and has a lasting impact on the performance and satisfaction of newcomers [13]. In addition, social-related proactive actions showed similarities with several social behaviors identified by previous studies (e.g., 24, 37). *Utilize Prior Network Connection* aligned with *Networking* identified by Ashford and Black [24]. *Attend Social Gatherings* and *Offer to Help Others* were in line with *General Socializing and Relationship Building* behaviors [24], namely, expanding the social network at the workplace and building relationships. Similarly, proactive actions such as *Possess Positive Work Ethics*, *Undertake Practical Tasks* aligned with *Positive Framing* [24] and *Reading* [22] behaviors reflecting newly-hired engineers' positive learning attitude in the socialization process.

Some actions, such as *Create Resources*, *Attempt Task Independently*, *Suggest Team Establishment* or



*Modification*, *Have a Strong Self-Belief*, and *Self-Study for Self-Improvement*, were rarely discussed in previous studies, probably due to the organizational contexts they examined. The present study addressed aerospace engineering organizations. The newly-hired engineers emphasized the importance of learning independently to enhance their skills and acquire the knowledge needed to perform engineering jobs and responsibilities. *Self-Study for Self-Improvement* reflected how newly-hired aerospace engineers worked intensely to master job-required skills and knowledge, mainly due to constant innovation in the field and being trained in various engineering disciplines [38, 39]. Hence, the actions mentioned above may be unique to aerospace engineers and the engineering context. This result contradicts previous studies addressing contexts such as accounting firms (e.g., [26]), co-op management programs (e.g., [23]), and temporary work agencies (e.g., [22]).

### 5.2 Proactive Actions Applicable to Single and Multiple Socialization Task Domains

In several instances, newly-hired engineers resorted to the same proactive actions to achieve different socialization task domains. For example, *Shadow or Observe Coworkers* led newly-hired engineers to achieve Role Clarification and Social Integration domains. Newly-hired engineers observed their senior coworkers' working process in the Role Clarification domain. However, they also observed their coworkers' social interactions and relationships with others in the Social Integration domain. The same action served two different purposes. In addition, a newcomer's purpose for attending meetings in the Role Clarification domain was to meet and understand the customers' needs. In contrast, in the Social Integration domain, the newcomer's purpose was to meet more coworkers.

No stand-alone proactive action existed in the Acculturation domain, indicating that acculturation occurred with other domains simultaneously. For example, three actions (*Attend Social Gatherings*, *Consider Coworkers' Point of View*, and *Have a Strong Self-Belief*) were performed together in the Acculturation and Social Integration domains. This finding implies that newly-hired engineers attempted to understand the organizational culture while achieving social integration. One reason why no stand-alone action existed in the Acculturation domain might be the study's homogenous participants (i.e., predominantly white males). Most study participants might have felt that their culture and the organization's culture were tied together. However, the acculturation process for newly-hired engineers from racially and ethnically diverse backgrounds could be different. New proactive actions

might emerge in this domain, given their socialization experiences and processes. However, addressing this point was beyond the scope of this study. Future research is needed to thoroughly examine proactive actions in the Acculturation domain.

In addition, only four proactive actions were taken in a single domain. Newly-hired engineers attempted work tasks independently and provided suggestions for team modification plans only in the Role Clarification domain. The purpose of *Self-Study for Self-Improvement* was taken for the mastering skills and knowledge the job required. Furthermore, newly-hired engineers only utilized their social network to meet more people and find available social events (*Utilize Prior Network Connection*) in the Social Integration domain. This finding suggests that only a small number of proactive actions occur independently in a single domain, and the socialization process consists of the same actions in multiple domains.

## 6. Implications

In-depth knowledge of the 16 proactive actions identified in the study may benefit engineering students and newly-hired engineers, engineering managers and organizations, and engineering educators.

The study's findings support the socialization of engineering students and new engineers, facilitating their adjustment to an aerospace organization and engineering workforce. Newly-hired engineers may use these findings to acquire the most helpful knowledge and strategies, reviewing and reflecting on their preparedness for entering professional engineering. In addition, they can take proactive actions to achieve the four different socialization task domains. The identified actions provide first-hand accounts of how newly-hired engineers cope with particular situations for given socialization task domains, which new engineers and students can study and model. For example, to improve their job performance and relationships with coworkers, newly-hired engineers may attend classes and work-group meetings to learn new skills, interacting with and shadowing coworkers to familiarize themselves with others in their organizations.

The study's findings may be integrated into engineering companies' training programs for new engineers, such as orientation, workshops, and mentorships. Providing newly-hired engineers with information about how they can effectively integrate at work may facilitate their transition into the company, potentially increasing their job satisfaction and performance. For example, newcomers may be asked to attend a workshop providing lessons drawn from the study's findings. Each

class may focus on a specific socialization task domain, and newcomers may be given opportunities to practice actions and processes. A simple workshop assignment may require newcomers to complete actions aligned with this study's findings and then reflect upon how well they have performed them. Such a learning environment may help newcomers retain what they learn and be more quickly immersed in the new workplace. A workplace mentorship program may help newcomers thrive. Mentors should be trained to help newcomers use the identified actions to successfully navigate social and professional challenges and fully integrate with the workplace culture. For example, managers should provide opportunities for newly-hired engineers to communicate with coworkers and help them establish their network (e.g., [40]). Moreover, orientation, workshops, and mentorships can be applied to internships in engineering organizations.

Finally, this study's findings clarify what future engineers need to know to socialize in aerospace companies. Engineering faculty may use this information to modify course curricula or provide students feedback that fosters their socialization competency. Offering students opportunities to practice socialization actions and processes during their education may mitigate future socialization challenges. For example, senior aerospace design courses provide significant opportunities for using the study's findings to teach socialization skills. These courses simulate a real engineering work environment and provide students with a professional-level engineering project. These courses may include understanding and applying socialization actions as a course objective. Students would have opportunities to practice using the identified actions and working effectively with classmates and advisers (faculty or practicing engineers). They may be encouraged to share these experiences with faculty during the semester. Faculty should provide mentorship and support in mastering socialization domains as students work on their projects. The study's findings may also guide (re)designing class activities and assignments, tailoring them to better train students' socialization abilities. Integrating socialization actions and processes into senior design courses would allow students to practice socialization experiences in a safe learning environment before graduation.

Overall, this study's findings fill a gap in the socialization literature, providing newly-graduated engineers with a useful list of socialization actions and information that can potentially change how engineering education and company training programs prepare engineering students to succeed in the aerospace profession. The study's findings may also support engineering organizations by helping

new engineering graduates quickly adapt to the workplace, become leading contributors, and achieve successful long-term careers in engineering.

## 7. Limitations and Future Research Directions

Despite its contributions, this study has some limitations. First, the research team recruited participants from four large, established aerospace organizations in the U.S. The actions identified by these participants may be commonly seen in other organizations and easily transferable. However, collecting data from newly-hired engineers working at different types of aerospace organizations, with different company sizes, years of establishment, and workforce size, may provide more diverse perspectives and proactive actions. Further, comparing actions from different organizations may provide crucial insights into companies' cultures, norms, and practices.

Second, in this study, most participants identified as white male engineers. Given the homogeneity of the participant group, the study's findings may not apply to different demographic groups. Newly-hired engineers' experiences and actions during the onboarding process may substantially differ depending on demographics (e.g., race, ethnicity, and gender) and experiences (e.g., participation in co-op or internship during college years). Therefore, future studies should collect data from diverse participants to examine the experiences and actions of members of specific demographic groups, such as women and members of underrepresented minorities from racially and ethnically diverse backgrounds. For example, in this study, one action more frequently mentioned by female than male engineers was *Have a Strong Self-Belief* action. Many female engineers discussed the importance of speaking up, bringing new ideas, and joining conversations during group or organization meetings. This result may suggest that female engineers must put extra effort into voicing opinions in the sample organizations. This attitude is critical in the aerospace profession since its workforce mostly consists of white male engineers, exposing women and minority engineers to the risk of inequalities and discrimination [41]. Moreover, the relationship between the identified actions and other factors of participants' previous experience (e.g., internship or co-op in the same or different organization where they are full-time employees) may lead to other unique actions.

## 8. Conclusion

This study explores the actions of newly-hired

engineers during their onboarding period in four large and established aerospace organizations. Sixteen proactive actions are identified and categorized according to four socialization task domains: role clarification, task mastery, acculturation into company norms and practice, and integration into workgroups. The identified actions are first-hand accounts from 26 engineers with less than three years of full-time experience. Some proactive actions achieve all or multiple socialization task domains, while others only achieve one domain.

The study's findings illustrate a broad variety of actions newly-hired engineers must practice during early integration into their organizations. Doing so, the study contributes to the engineering education

and management field, supporting the preparation of engineering students and the transition of recent graduate engineers into the engineering workforce. In addition, the study's results may potentially change or transform curriculum or onboarding programs in academic programs and organizations. Finally, future studies may investigate how proactive actions may differ across different types of engineering organizations and demographically diverse engineers.

*Acknowledgments* – This work was supported by the National Science Foundation under grant number EEC-1826388. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

## References

1. G. T. Chao, A. M. O'Leary-Kelly, S. Wolf, H. J. Klein and P. D. Gardner, Organizational socialization: Its content and consequences, *Journal of Applied Psychology*, **79**(5), pp. 730–743, 1994.
2. C. D. Fisher, Organizational socialization: An integrative review, *Research in Personnel and Human Resource Management*, **4**, pp. 101–145, 1986.
3. G. A. Miller and L. W. Wager, Adult socialization, organizational structure, and role orientations, *Administrative Science Quarterly*, **16**(2), p. 151, 1971.
4. E. H. Schein, Organizational socialization and the professional management, *Industrial Management Review*, **9**, pp. 1–16, 1967.
5. J. Van Maanen, Breaking in: socialization to work, In R. Dubin (ed), *Handbook of Work, Organization, and Society*, Rand McNally, Chicago, IL, pp. 67–130, 1976.
6. J. Van Maanen and E.H. Schein, Toward a theory of organizational socialization, *Research in Organizational Behavior*, **1**, pp. 209–264, 1979.
7. R. Katz, Organizational stress and early socialization experiences, In T. A. Beehr and R. S. Bhagat (eds), *Human Stress and Cognition in Organizations*, Wiley, New York, NY, pp. 117–139, 1985.
8. M. Louis, Surprise and sense making: What newcomers experience in entering unfamiliar organizational settings, *Administrative Science Quarterly*, **25**(2), pp. 226–251, 1980.
9. R. Katz, Organizational socialization and the reduction of uncertainty. In R. Katz (ed), *The Human Side of Managing Technological Innovation: A Collection of Readings*, Oxford University Press, New York, NY, pp. 34–47, 2004.
10. D. M. S. Lee, Job challenge, work effort, and job performance of young engineers: a causal analysis, *IEEE Transactions on Engineering Management*, **39**(3), pp. 214–226, 1992.
11. B. E. Ashforth, D. Sluss and A. Saks, Socialization tactics, proactive behavior, and newcomer learning: Integrating socialization models, *Journal of Vocational Behavior*, **70**(3), pp. 447–462, 2007.
12. T. N. Bauer, T. Bodner, B. Erdogan, D. M. Truxillo and J. S. Tucker, Newcomer adjustment during organizational socialization: A meta-analytic review of antecedents, outcomes, and methods, *Journal of Applied Psychology*, **92**(3), pp. 707–721, 2007.
13. R. F. Korte, How newcomers learn the social norms of an organization: A case study of the socialization of newly hired engineers, *Human Resource Development Quarterly*, **20**(3), pp. 285–306, 2009.
14. R. Korte, 'First, get to know them': a relational view of organizational socialization, *Human Resource Development International*, **13**(1), pp. 27–43, 2010.
15. C. Ostroff and S. W. J. Kozlowski, Organizational socialization as a learning process: The role of information acquisition, *Personnel Psychology*, **45**(4), pp. 849–874, 1992.
16. A. M. Saks, K. L. Uggerslev and N. E. Fassina, Socialization tactics and newcomer adjustment: A meta-analytic review and test of a model, *Journal of Vocational Behavior*, **70**(3), pp. 413–446, 2007.
17. I. Villanueva and L. S. Nadelson, Are we preparing our students to become engineers of the future or the past?, *International Journal of Engineering Education*, **33**(2), pp. 639–652, 2017.
18. L. S. Nadelson, S. P. McGuire, K. A. Davis, A. Farid, K. K. Hardy, Y. C. Hsu, U. Kaiser, R. Nagarajan and S. Wang, Am I a STEM professional? Documenting STEM student professional identity development, *Studies in Higher Education*, **42**(4), pp. 701–720, 2017.
19. R. F. Korte, S. Brunhaver and S. Sheppard, (Mis)Interpretations of Organizational Socialization: The Expectations and Experiences of Newcomers and Managers, *Human Resource Development Quarterly*, **26**(2), pp. 185–208, 2015.
20. K. Barnett, Student interns' socially constructed work realities: Narrowing the work expectation-reality gap, *Business Communication Quarterly*, **75**(3), pp. 271–290, 2012.
21. N. S. Edward and J. C. Middleton, Occupational socialisation – A new model of the engineer's formation. *International Conference on Engineering Education*, Oslo, Norway, August 6th to 10th, pp. 11–22, 2001.
22. H. D. Cooper-Thomas, N. L. Paterson, M. J. Stadler and A. M. Saks, The relative importance of proactive behaviors and outcomes for predicting newcomer learning, well-being, and work engagement, *Journal of Vocational Behavior*, **84**(3), pp. 318–331, 2014.
23. A. M. Saks, J. A. Gruman and H. Cooper-Thomas, The neglected role of proactive behavior and outcomes in newcomer socialization, *Journal of Vocational Behavior*, **79**(1), pp. 36–46, 2011.
24. S. J. Ashford and J. S. Black, Proactivity during organizational entry: The role of desire for control, *Journal of Applied Psychology*, **81**(2), pp. 199–214, 1996.

25. T.-Y. Kim, D. M. Cable and S.-P. Kim, Socialization tactics, employee proactivity, and person-organization fit, *Journal of Applied Psychology*, **90**(2), pp. 232–241, 2005.
26. E. W. Morrison, Longitudinal study of the effects of information seeking on newcomer socialization, *Journal of Applied Psychology*, **78**(2), pp. 173–183, 1993a.
27. E. W. Morrison, Newcomer information seeking: Exploring types, modes, sources, and outcomes, *Academy of Management Journal*, **36**(3), pp. 557–589, 1993b.
28. S. Billett, Co-participation at work: Learning through work and throughout working lives, *Studies in the Education of Adults*, **36**(2), pp. 190–205, 2004.
29. Collegiate Employment Research Institute, <http://www.ceri.msu.edu/wp-content/uploads/2010/01/skillsabrief1-2010.pdf>, Assessed 01 June, 2022.
30. K. J. B. Anderson, S. S. Courter, T. McGlamery, T. M. Nathans-Kelly and C. G. Nicometo, Understanding engineering work and identity: a cross-case analysis of engineers within six firms, *Engineering Studies*, **2**(3), pp. 153–174, 2010.
31. G. Scott and K. W. Yates, Using successful graduates to improve the quality of undergraduate engineering programmes, *European Journal of Engineering Education*, **27**(4), pp. 363–378, 2002.
32. J. W. Creswell, *Qualitative Inquiry and Research Design: Choosing among Five Approaches*, 3rd edn, Sage, Washington, DC, 2013.
33. K. M. Eisenhardt, Building theories from case study research. *The Academy of Management Journal*, **14**(4), pp. 532–550, 1989.
34. R. K. Yin, *Case Study Research: Design and Methods*, 3rd edn, Sage, Thousand Oaks, CA, 2003.
35. K. M. Eisenhardt and M. E. Graebner, Theory building from cases: Opportunities and challenges, *The Academy of Management Journal*, **50**(1), pp. 25–32, 2007.
36. M. B. Miles and A. M. Huberman, *Qualitative Data Analysis*, Sage, Newbury Park, 1994.
37. J. Wingerter, and B. Ahn, A Snapshot of the Socialization Process: Socialization Tactics, Behaviors, and Outcomes in the U.S. Aerospace and Defense Industry, *International Journal of Engineering Education*, **36**(3), pp. 1–19, 2020.
38. J. H. McMasters and R. M. Cummings, Airplane design-past, present, and future, *Journal of Aircraft*, **39**(1), pp. 10–17, 2002. Funk and Parker, 2018
39. S. Roy, Y. Dong, L. Baber and B. Ahn. Classroom to Workplace: Knowledge and Skills Learned by Recently Hired Aerospace Engineers. *Journal of Aerospace Information Systems*, **19**(4), pp. 317–329, 2022.
40. Y. Dong, B. Ahn and U. Tobey, Exploring Engineering Managers' Perspectives on the Actions of Engineering Managers and Newly Hired Engineers during the New Engineers' Socialization Period. *Engineering Management Journal*, **34**(3), pp. 343–356, 2022. DOI: 10.1080/10429247.2021.1922220
41. C. Funk and K. Parker, Women and men in STEM often at odds over workplace equity, *Pew Research Center*, January 2018.
42. M. Reber, Y. Dong, S. Roy and B. Ahn, Identifying the Challenges Aerospace Engineers Face during the Transition from University to Industry. *129th American Society of Engineering Education Annual Conference and Exposition*, Minneapolis, Minnesota, USA, June 26th to 29th, 2022

**Benjamin Ahn** is an Associate Professor in the Department of Engineering Education at The Ohio State University. His research interest includes (1) engineering workforce development, (2) student mentoring and diversity, and (3) teaching and learning mechanisms.

**Yun Dong** is an Adjunct Faculty in the Department of Visual and Performing Arts, Education, and Sciences at Waubensee Community College. Her research interest includes (1) new employees' onboarding experience, (2) interaction design for engineering education and training, and (3) design thinking in engineering workforce development.

**Secil Akinci-Ceylan** is a PhD student in Educational Technology in the School of Education at Iowa State University.