

Whistle While You Work: Drivers and Impacts of Happiness at Work for Engineers

Mr. Seth Claberon Sullivan, Texas A&M University

Seth Sullivan is the Director of the Zachry Leadership Program in the College of Engineering at Texas A&M University. Prior to joining the university, he worked in consulting in the private sector and as an analyst in the U.S. Government. Heâ€™s earned

Whistle While You Work: Antecedents and Impacts of Happiness at Work for Engineers

Abstract

This research explores the factors and conditions that lead engineers to feel happiness at work and examines how feeling happy at work impacts engineers. It draws on the body of literature published in the past ten years on this topic and includes a meta-analysis of the literature itself, identifying the geographical regions and industries that have been researched during that time period. The antecedents of happiness for engineers at work are varied, and include factors such as amount of responsibility, level of compensation, and relationships with co-workers. It demonstrates that happier engineers are more productive, producing better products with fewer mistakes. Very little research has been done on this topic, and the literature is highly international—half of the papers published in the past ten years focus on engineers outside of the United States. The findings suggest that leaders of engineers should invest time learning what makes engineers on their teams happy and allocate resources towards increasing their happiness in order to help them be productive and engaged.

I. Introduction

This research identifies the conditions that lead engineers to experience positive emotions such as happiness, satisfaction, and joy, and how happiness and other positive emotions impact them at work. It also identifies the scholars who have researched the topic, the types of journals to which they have contributed, and the industries within the field of engineering they have studied.

Increasing happiness at work, and measuring its impact, has been the subject of numerous studies across different cultures and industries. Research shows that it correlates with positive occupational outcomes. Specifically, happier employees exhibit higher levels of engagement, improved productivity, greater levels of career satisfaction, and a greater sense of well-being in their lives [1] – [4].

Singh, Saxenda, and Mahendru find that there is no widely-agreed upon definition of happiness in the literature, but they describe it as “a harmonious state where the individual’s physiological and psychological needs are satisfied in the past, present, and future, leading them to live a meaningful and contented life” [5]. To experience happiness at work, then, goes beyond job satisfaction. Other factors that contribute to happiness at work in any field include organizational commitment, job involvement, engagement, thriving and vigor, flow and intrinsic motivation, and affect at work [6].

According to the Bureau of Labor Statistics, three of the top 10 occupations with the highest projected percentage growth of employment between 2022 and 2032 are in the engineering field (wind turbine service technicians, data scientists, and software developers) [7]. However, my research identified only 10 peer-reviewed journal papers related to happiness in

engineers published since 2014, and no literature reviews that surveyed the research landscape on the topic. As the field of engineering continues to grow, better understanding the antecedents and impacts of happiness at work for engineers will be important for engineering researchers and practitioners who are interested in technical leadership and management, career development, and workforce development.

II. Research Questions and Methods

This literature review focuses on three questions:

1. What makes engineers happy at work?
2. How does feeling happy at work impact engineers?
3. What is the nature of the scholarly research that has been written about this topic?

A. Timeframe

This research is structured as a narrative literature review to assimilate peer-reviewed articles concerning engineers' happiness at work that were written between 2014 and the present. I chose to use this timeframe because my initial research indicated that little has been written about this topic, so a 10-year timeframe allows for a collection of literature sufficient to identify relevant theories, concepts, methods, and scholarly interests. It is recent enough to reflect current conditions, technological advances, and any changes in work-related happiness that occurred during or after the COVID-19 pandemic and associated adjustments to work practices. Also, this 10-year period included periods of economic growth and recession, so results should not be skewed by one prevailing macroeconomic condition.

B. First Search, Google Scholar

I performed my first search on happiness and engineering on Google Scholar using the keywords "happiness" and "engineering." I searched for "engineering" rather than "engineer" because I wanted to capture papers that mentioned happiness and any workers in engineering companies. This search produced 59,800 results, which I sorted by relevance. Beginning with the most relevant, I read the article titles and summaries. I opened and read the abstract for each that appeared relevant to my interests. If the abstract confirmed the paper's relevance, I read the entire paper and logged it in a matrix (see appendix).

There were many false-positive results in the list. Some were written about the field of engineering education. I did not include those papers written about engineering students' happiness because it was outside the scope of this research, which is focused on happiness in engineering work, not in engineering academic studies. There were also many papers that used the word engineering in the context of creating something as opposed to the career; for example, one paper that the search returned was titled, "Reverse engineering social media." I reviewed the first 200 articles sorted by relevance. The last 100 did not contain any that were relevant to my research interests. In total, this search returned five papers that were relevant.

C. Same Search, University Library Database

Next, I performed the same search on the university library's online databases—specifically, Engineering Village, Web of Science, ScienceDirect, and Wiley Online Library. I filtered search results to only show peer-reviewed literature that had been published in scholarly journals or presented at academic conferences, over the same time period: 2014 – present. This database search returned a total of 3,760 results, which I analyzed using the same method described above. Again, the vast majority of the papers did not address my research questions. I found four of the same articles observed on Google Scholar, and one additional paper.

D. Expanding the Search String

The small number of articles I found that addressed my research questions prompted me to expand my search string. Recognizing that my search may not have captured all of the research done, I expanded it by adding several terms with OR operators in a Boolean search. My new search string was (engineering OR engineer OR technical) AND (happy OR happiness OR satisfaction OR joy). As discussed above, “satisfaction” and “happiness” in the context of professional work are similar, but happiness connotes a more emotional response than simple satisfaction or contentment. However, in reading through papers in my initial search, I realized that including the word “satisfaction” could capture some interesting insights that would be helpful to consider. This was confirmed in the results. Subagja's research on the effect of motivation and job satisfaction on employee performance defined satisfaction as, “a feeling of pleasure that arises for someone after comparing their experience with their expectations” [8]. I decided to include this paper in my research because the author's definition included an emotional component.

This search string, using the timeframe 2014 – Present, returned 1.9 million papers on Google Scholar—far too many to review in totality. However, I examined the first 200 papers returned, sorted by relevance, and added four additional papers to my literature matrix. The same search string and time frame in Engineering Village, Web of Science, ScienceDirect, and Wiley Online Library returned 180,709 peer-reviewed results (including articles, books, trade publications, and conference materials). I reviewed the first 100 but did not find any that addressed my research questions.

The broader search returned more results, but too many to evaluate. Many of the results contained the word “satisfaction,” but they did not involve emotions such as happiness, joy, or even euphoria. Rather, the term “satisfaction” often indicated little beyond an employee not quietly quitting or actively seeking a new job.

IV. Findings

These findings are organized according to the three research questions shared above, in three respective sections. First, the literature reveals six conditions that make engineers happy at work. Second, it describes the impact of being happy on engineers' productivity. Finally, it provides insight into the backgrounds of the scholars who have published on this topic, the journals to which they contribute, and the methods they have used to explore the phenomenon.

A. What Makes Engineers Happy at Work?

The literature reveals a wide range of factors that either drive happiness among engineers or are correlated with it. Engineers who are junior and do not feel the same level of stress and responsibility as their senior counterparts are happier, as are those with middle to high levels of relative income [9]. Women who reported being happy with their jobs mentioned feeling support from their co-workers and career development opportunities, along with physical protection—important in the context of the study, which was on construction sites in Turkey—as drivers of happiness [10]. Other factors identified as antecedents to engineers’ happiness at work included strong team, organizational, and societal cultures and meeting expectations around work-life balance [11]. Psychological well-being is correlated with both happiness and performance in engineers in the construction industry in Sri Lanka [9], which was also found to be true among private sector employees in various professions in South Korea [2].

Graziotin and Fagerholm also identified drivers of unhappiness among software engineers. Software engineers felt unhappy when they felt “stuck” trying to solve a difficult coding problem or when they experienced time pressure. When they felt like they were working in bad systems, they also reported feeling unhappy [12]. Other research showed that engineers felt less happy when working in organizations with high levels of organizational cynicism—those that had a negative, pessimistic culture [13].

B. How Does Feeling Happy at Work Impact Engineers?

The literature I reviewed on happiness and productivity in general shows a correlation between the two. Zelenski, Murphy, and Jenkins’ research on the happy-productive worker thesis found happy workers to be more productive; and that positive affect had a strong relationship with productivity [4]. Similarly, Oswald, Proto, and Sgroi concluded that happiness makes people more productive [3]. This conclusion was informed by their research that showed randomly-selected people a clip from a comedy movie, then measuring their productivity on a standardized task. Their productivity was then compared to the productivity of a control group who did not watch the movie. The happier group was 12% more productive than the control group and over time, subjects who demonstrated the greatest improvement in happiness levels also recorded the greatest boosts in productivity. In the same study [3], the authors found subjects who had recently experienced real-world shocks that produced negative affect, such as family tragedies, were significantly less productive than those who had not.

The engineering literature affirms these findings. San Santoso and Kulathunga found a moderate positive correlation between happiness and performance in their study of engineers in the construction industry in Sri Lanka (this study examined performance, rather than productivity, but in this case, the terms appear similar enough to be considered) [9]. Happy software engineers also outperform unhappy software engineers by 6% and produce higher quality code [12], [14].

Besides increasing productivity and performance, increasing happiness also has other positive impacts on engineers. They exhibit higher levels of motivation, expediate work more effectively, and reach and sustain flow state more often [14]. Women engineers who are happy at work believe they are adding value to their male-majority teams through gendered skills and

strengths that their male counterparts seem to lack [10]. Happy software engineers are more collaborative in their teams and produce higher quality code [12].

C. What is the nature of the scholarly research that has been written about this topic?

The literature that has been published about this topic has covered a variety of industries within the engineering discipline. The research is limited but global—I found only 10 relevant papers, but they research happiness among engineers in seven different countries. Nonetheless, some interesting similarities emerged.

1) Authors and Sources: The existing literature on the antecedents and impacts of happiness engineers experience at work is very limited. Of the ten papers that specifically address the topic, two were written by the same authors. Of the ten papers, five had United States-based authors and five were authored by scholars that work at universities outside the United States. The perspective on this topic in the existing literature I reviewed is highly international.

No two papers were published in the same journal; research was published in ten different sources, all but one of which are engineering books, journals, or conferences. Five of the sources were industry-specific (three in the field of software development)—*Rethinking productivity in software engineering*, *Journal of Construction Engineering and Management*, *Engineering Construction and Architectural Management*, *I-Manager's Journal on Software Engineering*, and *Journal of Systems and Software*. One of the sources was in the field of engineering management—*IEEE Engineering Management Review*; and one was in general engineering—*Procedia Engineering*.

2) Industries: Three papers researched engineers in the software industry [12], [14], [15]. These engineers are sometimes referred to in academia and industry as software developers. Two of the papers researched engineers in the construction industry [9], [10] and one of those two specifically examined how women engineers in the construction industry experience happiness at work [10]. Five of the papers did not specify the industry that was examined [8], [11], [13], [16], [17].

3) Methods and Approaches: Examination of the methods and approaches used in each paper revealed a dearth of theories applied to the topic. None of the papers on happiness for engineers strongly leveraged existing theories in human resource development, leadership, management, or psychology. Authors did employ a variety of research methods, including Likert-scale questionnaires, self-assessment, manager assessment, and qualitative analysis of open-ended questions and semi-structured interviews. Graziotin and Fagerholm published two papers on happiness of software engineers, and both drew on the Scale of Positive and Negative Experience-Balance (SPANB) instrument used to assess positive and negative affect [12], [14]. This quantitative instrument consists of twelve items—six that assess positive feelings, and six that assess negative feelings.

V. Discussion

A deeper look at the findings reveals some interesting questions. Why do engineers with less responsibility feel more happiness than engineers with more responsibility? Why did a study of women engineers' happiness highlight the importance of relationships with co-workers, but the other studies did not? Why does so much of the research focus on engineers outside of the United States? This section explores these questions, as well as the limitations of this literature review.

A. Engineers are Happier with Less Responsibility

The finding that engineers are happiest when they do not feel the pressure of numerous, weighty responsibilities is surprising, and challenges my assumption that those with high levels of responsibility feel more satisfied because of the larger impact of their work. One possible explanation is that the higher levels of responsibility include more leadership and humanistic tasks, which engineering curriculum typically does not cover extensively [18], and which they have not had to do in their early-career roles. These engineers, who may have performed individual contributor tasks for most of their careers, may feel unprepared and unconfident, and thus unhappy, when placed in higher-responsibility leadership positions. Another possible explanation is that engineers feel like the higher responsibility tasks are not necessarily more impactful than are the lower-level tasks. As technically-minded professionals, many may find more enjoyment and happiness in more technical roles.

B. Female Engineers' Relationships with Co-Workers

Positive relationships with co-workers was one of the first antecedents of happiness raised in a study of female engineers on construction sites in Turkey [10], but relationships were not a significant factor in driving happiness in the other studies. Engineers are often portrayed in the popular press as introverts who are more focused on their technical tasks than on building interpersonal relationships. For the women in this study, however, relationships played a significant role in their happiness at work; women who experience positive relationships at work are happier, which, according to other studies, makes them more productive at work [2] – [4].

C. Heavy International Influence in the Research

The study of happiness in engineers over the past ten years has been very balanced between US-based researchers and international researchers. This might suggest that scholars in other countries are more concerned with employees' emotional state and feeling of pleasantness at work than are those in the United States. If U.S. scholars are more focused on productivity and performance than emotion, the research linking the two indicates time spent learning more about the antecedents of happiness would be well spent since happier workers have been shown to be more productive [2] – [4].

D. Limitations

In this narrative literature review, I sought to assemble an overview of the literature that had been published in the past ten years about engineers' happiness at work. Several limitations prevented a comprehensive review, but also offer opportunities for future research. One limitation is that I did not apply any specific literature framework, such as PRISMA, PICO, or SPIDER. A more structured literature review framework could yield better results. Also, this

review does not include other possibly relevant concepts, such as engagement, that could provide additional insights into engineers' happiness at work. Finally, and perhaps most significantly, this literature review does not compare engineers' happiness at work to any other professional field's happiness. Therefore, the findings may not be specific to engineers and many of the antecedents and impacts could apply to other professions, as well.

VI. Implications

A. Implications for Practice

The findings on what makes engineers happy (or unhappy) at work and how feeling happy at work impacts engineers provide important data for engineering leaders and leaders who work with engineers to consider. Most importantly, the research is clear that happy engineers do better quality work faster, and are less likely to leave their positions. Leaders, then, should invest in learning about their engineering employees and what makes them happy at work. While it may feel unnatural for some leaders, contributing to their employees' happiness is an important function for a leader who wants to have a high-performing, successful team. Unfortunately, the factors identified in the research that lead to happiness were not unanimous, and in fact, were not even consistent. The leader, therefore, must take the time to observe his or her employees at work, to ask what makes them happy, and to listen to their responses. Then, she or he must secure the resources necessary to provide those factors and institute them.

If the engineers are happiest when they have good relationships with co-workers, the leader should invest in teambuilding activities and create opportunities for the engineers to engage in a casual, nonprofessional setting. If they are less happy with more responsibility, the leader should ascertain whether it is really the amount of responsibility, or how prepared the engineers feel to handle that responsibility that leads to the decrease in happiness; if it is the latter, training or mentoring programs may help the engineer feel more confident and capable of handling the necessary responsibilities. If they are happiest with strong organizational systems in place that reduce ambiguity and duplication of effort, the leader should work with their human resource development professional to implement organizational development efforts intended to achieve that type of organization.

The small amount of research that has been done in the past ten years presents many opportunities for scholars. Engineers can work in many different environments, from cubicles in corporate offices to remote job sites. Do engineers tend to be happier in certain environments, and if so, why? More research needs to be done in general, but specifically in Latin America and Africa, where I did not find any results. Scholars could also examine in more depth the connections between seniority, leadership responsibility, feeling of preparedness, and happiness. There are also many fields within engineering—scholars could examine happiness levels in each to compare them. Finally, scholars have an opportunity to introduce new models and theories in this field, since few appear in the current body of literature.

B. Implications for Research

This initial review of the literature around the antecedents and impacts of happiness at work for engineers offers possibilities for future research in several different directions. Future work that compared the literature on happiness at work more broadly against happiness at work

for engineers, specifically, could help us understand which, if any, antecedents and impacts are unique to engineers. The small body of literature addressing engineers' happiness, specifically, presents opportunities for further empirical studies, especially on engineers in the workplace (as opposed to students studying engineering), in different fields of engineering, and among different demographic groups of engineers. Finally, further research could be done to define and distinguish between terms such as "happiness," "engagement," "satisfaction," and "experience" in the engineering field, as well as more broadly.

References

- [1] El-Sharkawy, S. A., Nafea, M. S., & Hassan, E. E. D. H. (2023). HRM and organizational learning in knowledge economy: investigating the impact of happiness at work (HAW) on organizational learning capability (OLC). *Future Business Journal*, 9(1), 10-25.
- [2] Joo, B & Lee I (2017). Workplace happiness: work engagement, career satisfaction, and subjective well-being. *Evidence-Based HRM*, 5(2), 206-221.
- [3] Oswald, A. J., Proto, E., & Sgroi, D. (2015). Happiness and productivity. *Journal of Labor Economics*, 33(4), 789-822.
- [4] Zelenski, J. M., Murphy, S. A., & Jenkins, D. A. (2008). The happy-productive worker thesis revisited. *Journal of Happiness Studies*, 9(4), 521-537.
- [5] Singh, K., Saxena, G., & Mahendru, M. (2023). Revisiting the determinants of happiness from a grounded theory approach. *International Journal of Ethics and Systems*, 39(1), 21-35.
- [6] Fisher, C. D. (2010). Happiness at work. *International journal of management reviews*, 12(4), 384-412.
- [7] U.S. Bureau of Labor Statistics (2022). Fastest growing occupations. *Occupational Outlook Handbook*. <https://www.bls.gov/ooh/fastest-growing.htm>
- [8] Subagja, I. K. (2020). Effect of motivation and job satisfaction on employee performance through working discipline at PT. Bamboo Tirta Engineering. *International Journal of Business and Social Science Research*, 1(1), 28-35.
- [9] San Santoso, D., & Kulathunga, H. E. R. (2016). Examining happiness: Towards better understanding of performance improvement. *Procedia Engineering*, 164, 354-361.
- [10] Chew, Y. T. E., Atay, E., & Bayraktaroglu, S. (2020). Female engineers' happiness and productivity in organizations with paternalistic culture. *Journal of Construction Engineering and Management*, 146(6), 05020005-1 – 05020005-12.
- [11] Biggadike, C., Ahumada-Tello, E., Evans, R., & Wehde, M. (2023). Cultural hierarchies, leadership, and employee happiness. *IEEE Engineering Management Review*, 51(3), 8-12.
- [12] Graziotin, D., & Fagerholm, F. (2019). Happiness and the productivity of software engineers. In C. Sadowski & T. Zimmerman (Eds.), *Rethinking Productivity in Software Engineering*, pp. 109-124. Apress Media.

- [13] Khan, R., Naseem, A., & Masood, S. A. (2016). Effect of continuance commitment and organizational cynicism on employee satisfaction in engineering organizations. *International journal of innovation, management and technology*, 7(4), 141-146.
- [14] Graziotin, D., Fagerholm, F., Wang, X., & Abrahamsson, P. (2018). What happens when software developers are (un) happy. *Journal of Systems and Software*, 140, 32-47.
- [15] Yaseen, M., Ali, Z., & Rahman, A. U. (2019). Role of software Developer's happiness in projects success: A proposed developers happiness model (DHM). *I-Manager's Journal on Software Engineering*, 14(1), 34-41.
- [16] Hofaidhllaoui, M., & Chhinzer, N. (2014). The relationship between satisfaction and turnover intentions for knowledge workers. *Engineering Management Journal*, 26(2), 3-9.
- [17] WY Tam, V., & Zeng, S. X. (2014). Employee job satisfaction in engineering firms. *Engineering, Construction and Architectural Management*, 21(4), 353-368.
- [18] S. Kumar and J. K. Hsiao, "Engineers Learn 'Soft Skills the Hard Way': Planting a Seed of Leadership in Engineering Classes," *Leadership and Management in Engineering*, vol. 7, no. 1, pp. 18–23, Jan. 2007, doi: [https://doi.org/10.1061/\(asce\)1532-6748\(2007\)7:1\(18\)](https://doi.org/10.1061/(asce)1532-6748(2007)7:1(18)).

Appendix

Title	Authors, Year	Purpose	Methods	Findings	Citation
Papers about Happiness at work (in general) - background					
HRM and organizational learning in knowledge economy: investigating the impact of happiness at work (HAW) on organizational learning capability	El-Sharkawy, Nafea, & Hassan, 2023	Examine the role of work-life balance and recognition as antecedents of org learning capability through the mediating effect of happiness at work	Cross-sectional survey	HAW plays an important role in mediating the relationship between recognition and WLB, and OLC	El-Sharkawy, S. A., Nafea, M. S., & Hassan, E. E. D. H. (2023). HRM and organizational learning in knowledge economy: investigating the impact of happiness at work (HAW) on organizational learning capability (OLC). <i>Future Business Journal</i> , 9(1), 10-25.
Happiness at Work	Fisher, 2010	To define happiness in the work context and review what is know about the causes and consequences of HAW	Literature review	<ol style="list-style-type: none"> 1.A measure of individual-level happiness might include work engagement, job satisfaction, and affective organizational commitment 2.Happiness must be measured at various levels, including transient experiences, stable person-level attitudes, and collective attitudes 	Fisher, C. D. (2010). Happiness at work. <i>International journal of management reviews</i> , 12(4), 384-412.
Revisiting the determinants of happiness from a grounded theory approach	Singh, Saxena, and Mahendru, 2023	To examine lay notions of happiness and determine the factors that influence one's experience of happiness	Open-ended questionnaire	<ol style="list-style-type: none"> 1.Happiness is defined as a harmonious state where the individual's physiological and psychological needs are satisfied in the past, present, and future, leading them to live a meaningful and contented life 2.Factors that affect happiness: family and friends, health and wellness, personal and 	Singh, K., Saxena, G., & Mahendru, M. (2023). Revisiting the determinants of happiness from a grounded theory approach. <i>International Journal of Ethics and Systems</i> , 39(1), 21-35.

				<p>professional success, recreation, and personal traits</p> <p>3. Impeders: unfavorable surroundings, work and play impediments, strained relationships, undesirable behavioral characteristics</p>	
Workplace happiness: work engagement, career satisfaction, and subjective well-being	Joo and Lee, 2017	To investigate effects of perceived organizational support and psychological capital on happiness in employees' work, careers, and lives	Quant study of 550 employees of business in South Korea	<p>1. Employees were highly engaged in work, satisfied with their careers, and felt a greater sense of well-being in their lives when they had higher POS and psych cap</p>	Joo, B & Lee I (2017). Workplace happiness: work engagement, career satisfaction, and subjective well-being. <i>Evidence-Based HRM</i> , 5(2), 206-221.
The Happy-Productive Worker Thesis Revisited	Zelenski, Murphy, and Jenkins, 2008	To reconcile a long history of mixed findings on the happy-productive worker thesis	Longitudinal study of 75 Directors using questionnaires	<p>1. Happier workers were found to be more productive</p> <p>2. Positive affect had strong relationship with productivity, but negative affect had no relationship</p> <p>3. Happiness was related to productivity at both the trait and state levels of analysis</p>	Zelenski, J. M., Murphy, S. A., & Jenkins, D. A. (2008). The happy-productive worker thesis revisited. <i>Journal of Happiness Studies</i> , 9(4), 521-537.
Happiness and Productivity	Oswald, Proto, and SgROI, 2015	To investigate claims that happy workers are more productive		<p>1. Happiness makes people more productive</p> <p>2. Randomly selected people made happier are 12% more productive</p> <p>3. People dealing with real-world shocks (unhappiness) systematically associated with lower productivity</p>	Oswald, A. J., Proto, E., & SgROI, D. (2015). Happiness and productivity. <i>Journal of Labor Economics</i> , 33(4), 789-822.
Google Scholar search for "happiness" and "engineering"					

<p>Examining Happiness: Towards Better Understanding of Performance Improvement</p>	<p>San Santoso, Kulathunga, 2016</p>	<p>Examine relationship between happiness and performance in among engineers in the construction industry</p>	<p>Questionnaire survey with 5-point Likert scale to measure happiness; two measures of performance: self-assessment and supervisor’s assessment</p> <p>Sri Lankan engineers in construction industry</p>	<ol style="list-style-type: none"> 1. Performance has moderate positive correlation with happiness 2. Psychological well-being has stronger correlation with performance than does happiness 3. Psych. Well-being explains less than 13% of happiness, so other factors involved 4. No correlation between stress and happiness 5. Single engineers are happier than marrieds 6. Junior engineers are happier than seniors; juniors perceive less stress also, and less responsibility 7. Middle and high income engineers are happier than low income <p>Future studies:</p> <ul style="list-style-type: none"> • Longitudinal studies 	<p>San Santoso, D., & Kulathunga, H. E. R. (2016). Examining happiness: Towards better understanding of performance improvement. <i>Procedia Engineering</i>, 164, 354-361.</p>
<p>Happiness and the Productivity of Software Engineers</p>	<p>Graziotin and Fagerholm, 2019</p>	<p>Examine studies of happiness of software engineers</p>	<p>Mixed; used SPAN-B to measure levels of happiness; open-ended questions</p>	<ol style="list-style-type: none"> 1. Most software engineers are moderately happy (avg. score of 9.05 on a -24 to 24 scale); other similar studies show positive numbers but smaller 2. Two leading factors of unhappiness: being “stuck” solving a problem, and time pressure 3. Another—working with bad code practices 4. Consequences of unhappiness are internal (low cognitive performance, mental unease, 	<p>Graziotin, D., & Fagerholm, F. (2019). Happiness and the productivity of software engineers. In C. Sadowski & T. Zimmerman (Eds.), <i>Rethinking Productivity in Software Engineering</i>, 109-124. Apress Media.</p>

				<p>low motivation, quiet quitting) and external (delay, low productivity, process deviations, low quality, etc.)</p> <p>5. Happy engineers outperformed unhappy engineers by 6%</p> <p>6. Happy engineers are more collaborative</p> <p>7. Happy engineers produce higher quality code</p>	
<p>Female Engineers' Happiness and Productivity in Organizations with Paternalistic Culture</p>	<p>Chew, Atay, and Bayraktaroglu, 2020</p>	<p>Understand the work experience of female engineers in Turkey and how positive social exchange between employer and employee may bring job satisfaction and productivity</p>	<p>Open-ended and in-depth semistructured interviews with 19 female engineers at construction sites in Turkey</p>	<p>1. Women engineers experience unwelcome gender-related social norms and stereotyping</p> <p>2. See themselves as adding value through gendered skills and strengths they believe men lack—caring, patience, optimism, kindness, meticulousness, good planning, etc.</p> <p>3. 16 of 19 stated they were happy with their jobs, appreciative of the provisions of support, protection, and career development opportunities</p>	<p>Chew, Y. T. E., Atay, E., & Bayraktaroglu, S. (2020). Female engineers' happiness and productivity in organizations with paternalistic culture. <i>Journal of Construction Engineering and Management</i>, 146(6), 1-12.</p>
<p>What happens when software developers are (un)happy</p>	<p>Graziotin, Fagerholm, Wang, Abrahamsson, 2018</p>	<p>To study what happens when developers are happy and unhappy</p>	<p>Qualitative study of 300 software engineers' experiences; used SPANE instrument with 12 items assessing happiness and two open-ended questions</p>	<p>1. Internal consequences of unhappiness are low cognitive performance, mental unease or disorder, low motivation, work withdrawal</p> <p>2. External consequences are low productivity, delay, decreased process adherence, broken flow, low code quality, discharging code</p>	<p>Graziotin, D., Fagerholm, F., Wang, X., & Abrahamsson, P. (2018). What happens when software developers are (un)happy. <i>Journal of Systems and Software</i>, 140, 32-47.</p>

				<p>3.Internal consequences of happiness are high productivity, high motivation, high code quality</p> <p>4.External consequences are high productivity, expeditation, increased collaboration, sustained flow</p> <p>5.Most consequences of unhappiness are external, most consequences of happiness are internal</p>	
Cultural Hierarchies, Leadership, and Employee Happiness	Biggadike, Ahumada-Tello, Evans, Wehde, 2023	To provide practical implications for engineering managers wanting to develop business or team culture, leadership, and employee happiness while seeking to promote productivity and engagement	Unknown	<p>1.Engineering managers must understand that team’s perception of work is influenced by societal, organizational, and team cultures.</p> <p>2.Understanding what drives employee happiness is critical for development of leadership strategies, especially in tech fields</p> <p>3.Leaders in engineering must engage in leadership actions that focus on employees’ beliefs, wants, and expectations around work-life balance</p>	Biggadike, C., Ahumada-Tello, E., Evans, R., & Wehde, M. (2023). Cultural Hierarchies, Leadership, and Employee Happiness. <i>IEEE Engineering Management Review</i> , 51(3), 8-12.
Database (Engineering Village, Web of Science, ScienceDirect, Wiley Online Library) search for “happiness” and “engineering”					
Role of software developer’s happiness in project success: A proposed developer’s happiness model (DHM)	Yaseen, Ali, and Rahman, 2019	To investigate the critical factors of developers’ happiness and mood affecters	Questionnaires	1.We need to identify factors that bring happiness or reduce stress for developers	Yaseen, M., Ali, Z., & Rahman, A. U. (2019). Role of software Developer’s happiness in projects success: A proposed developers happiness model (DHM). <i>I-Manager's Journal on</i>

					<i>Software Engineering, 14(1), 34-41.</i>
Google Scholar search for (engineering OR engineer OR technical) AND (happy OR happiness OR satisfaction OR joy)					
Effect of Continuance Commitment and Organizational Cynicism on Employee Satisfaction in Engineering Organizations	Khan, Naseem, and Masood, 2016	To assess the effect of continuance commitment and organizational cynicism on employee job satisfaction.	Structured questionnaires of 106 employees in engineering organizations in Pakistan	<ol style="list-style-type: none"> 1.Negative correlation between organizational cynicism and employee job satisfaction – employees are less satisfied (happy) in organizations that have high levels of cynicism 2.Positive correlation between continuance commitment and satisfaction – employees are more satisfied (happy) when they feel like they would lose more than they would gain by leaving their jobs 	Khan, R., Naseem, A., & Masood, S. A. (2016). Effect of continuance commitment and organizational cynicism on employee satisfaction in engineering organizations. <i>International journal of innovation, management and technology, 7(4), 141-146.</i>
Effect of Motivation and Job Satisfaction on Employee Performance Through Working Discipline at Pt. Bamboo Tirta Engineering	Subagja, 2020	To assess the impact of motivation and job satisfaction on work discipline and performance; to assess the impact of work discipline on performance	64 employees of an engineering company in Indonesia were assessed	<ol style="list-style-type: none"> 1.Motivation and job satisfaction do affect work discipline 2.Motivation and job satisfaction do affect performance <p>Satisfaction is defined as a feeling of pleasure that arises for someone after comparing their experience with their expectations.</p> <p>Work discipline is defined as an employee’s compliance and willingness to follow company rules and social norms.</p>	Subagja, I. K. (2020). Effect of motivation and job satisfaction on employee performance through working discipline at PT. Bamboo Tirta Engineering. <i>International Journal of Business and Social Science Research, 1(1), 28-35.</i>
Employee job satisfaction in engineering firms	Tam and Zeng, 2014	To examine the relationship among cultural values, using the dimension of	Questionnaires of over 10,000 employees of leading engineering firms	1.Highest determinants of job satisfaction were “work,” “co-workers,” and “operating procedures”	WY Tam, V., & Zeng, S. X. (2014). Employee job satisfaction in engineering firms. <i>Engineering, Construction and</i>

		power distance (PD), and employee job satisfaction in engineering firms in the UAE and Saudi Arabia	in the two countries; PD is independent variable, measured by Hofstede's model; job satisfaction is dependent, measured using Job Satisfaction Survey (JSS)	<ol style="list-style-type: none"> 2. "Opportunities for promotion" and "reward" are least 3. Efficient working procedures extremely important to engineers 4. Avoiding duplication of work flows is important 5. Communication, benefits, and supervision also important 	<i>Architectural Management</i> , 21(4), 353-368.
The Relationship Between Satisfaction and Turnover Intentions for Knowledge Workers	Hofaidhllaoui and Chhinzer, 2014	To examine the influence of assessment of perceived alternative employment opportunities and positive organizational support on the relationship between the two facets of job satisfaction (with work and with supervisor) among knowledge workers, specifically engineers	Surveys of 481 engineers; satisfaction was measured using Roussel's syntax (based on Minnesota Satisfaction Questionnaire); turnover intentions measured using first three items of Rusbult et al.'s scale	<ol style="list-style-type: none"> 1. Higher satisfaction with supervisor and with work correlate with lower turnover intention 2. Satisfaction with work and supervisor are uncorrelated 3. When external employment opportunities are perceived as ample, or when positive organizational support is perceived as low, then relationship between satisfaction and turnover intention is low – even if engineers have a bad relationship with their boss or don't like their job, they are not likely to leave if they deem the job market weak or level of org support as high 	Hofaidhllaoui, M., & Chhinzer, N. (2014). The relationship between satisfaction and turnover intentions for knowledge workers. <i>Engineering Management Journal</i> , 26(2), 3-9.