Managing Software Engineers' Engagement and the Psychological Contract to Promote Innovation: A Review of the Current Trends in the American Technology Industry.

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Abstract

This study investigates the role of engagement in retaining software engineers in the current environment of the American tech industry. Software engineers are at the centre of the emergent innovation that most tech firms rely upon, which is shifting away from being based on separated R+D department and rather focusing more on innovation emerging from the delivery team which is in direct contact with the customers.

Engagement and the psychological contract have been studied in general, and in other industries. Some studies pertinent to the IT sector exist, but limited literature covers specifically software engineers in the tech industry, where engineers are markedly perceived by the management as a revenue generator and an agent for innovation rather than as a cost centre.

The study presented is inductive and explorative in nature, involving a set of semi-structured interviews with engineering managers in the American tech industry. The aspect of financial compensation is reviewed in the literature, but not included in the investigation.

In terms of engagement, the main findings are that software engineers seems to not be motivated by free lunches or other extravagant perks projected by the tech industry, especially in spots like the Silicon Valley. The managers interviewed found other levers to be motivating for engineers: putting them in a position to solve either interesting or challenging problems, giving them direct visibility over the customers' needs and the management's agenda, allowing them the autonomy to look and work across silos, provide skill growth depending on where they are in their career and provide shared goals at team levels. Very limited breaches of the psychological contract were reported, indicating that

the psychological contract may generally be well maintained in this industry. The pervasive use of one on one meetings, goal setting and extensive interviewing processes, involving several different touch points with the team, seem to be the main factors behind this phenomenon.

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Introduction

A shift away from a traditional Research and Development model has been noted in the last decades for the tech industry. The nature of the personal computer revolution, experiences such as Xerox Parc, and new work methodologies such as Agile have enticed tech companies to rely less on separate R+D departments and instead embed innovation and product development (where and when possible) directly in the delivery team. Software engineers play a central role in this model as knowledge workers who employ their knowledge to applied "manual" work. For this reason, software engineers in the current tech market in the United States can command substantial compensation, and they are hard to recruit.

Literature review

To contextualize the study in this chapter we will first review the current HR practices in the technology sector in the United States. We will highlight the push away from traditional R+D departments in the tech sector in favour of integrating the product development directly in the engineering operations. We will see how in the technology sector the engineers' productivity and creativity takes a leading role, and how this is mediated by their engagement with their company, their position and their team. We will also touch upon the increasing cost of engineering for tech firms, and motivation and the psychological contract in the context of talent retention.

United States Tech Sector Background

What do we mean by "tech sector"?

An important distinction needs to be introduced at the outset. The scope of this paper concerns the tech sector in the United States and the software engineers (also called developers) within this space. There does not seem to be a precise and specific definition for this sector, but the main distinction is within the Information Technology sector in general. We refer to the tech sector as a subset of the broader IT sector with firms and companies whose main final product is software itself or heavily software related, rather than the IT departments of firms whose products are not software driven. An example of the first would be Google, Facebook, Apple, Amazon, and Microsoft. The latter case would be represented by the IT department of Tesco, where software is an internal service and therefore a cost centre rather than a revenue generating resource. Papers that consider the IT sector focus on the IT division of larger corporations, for example the petroleum and convenience store sector (Moquin & Riemenschneider, 2014). While some of the considerations of this paper will apply to all scenarios, the primary object of this analysis is firm whose product is the software, or it is driven by the software.

Emergent and Engineer-Based Research and Development

It is usual for companies in general to have a Research and Development division whose activity and goal is the creation of new product / services. It is also customary for this to be detached from the other functions of the firm that are instead focused on delivering the product / service that is the company's objective. This was also standard for many large tech firms: until recently both Microsoft and Yahoo had separate Research and

Development divisions (MacMillan & Stone, 2013), (Maarek, 2016), (Sullivan, 2014) (Dua, 2016).

This classic R&D department model is in contrast with the startup spirit of Silicon Valley, where innovation is expected to be emergent and embedded directly in the engineering and delivery team rather than being a separate division. A brief review of the history of the tech revolution discloses the reason for this attitude. The Personal Computer revolution of the late 70s and 80s shifted the creative power from large corporations (e.g. IBM) to smaller, nimbler operations (MITS, Microsoft, Apple) (Cringely, 1996), in many cases emerging from a hobbyist environment (e.g. the Homebrew Computer Club in the Bay area in the mid and late 70s) (Levy, 2010, pp. 201-227). This experience showed that the time to market for innovation is crucial, and an organization where the process is encumbered by organizational barriers between divisions is bound to fail. Even IBM recognized this in the early 80s and, to enter in the Personal Computer space, it spun off a separate division, detached from the main IBM decision structure (Cringely, 1996).

The catastrophic failure of Xerox PARC later on showed the pitfalls of the separated R+D department model to ensuing tech firms. Xerox set up an R+D department called PARC, which in the late 70s went on to invent paradigms and technologies that shaped (and still shape) the technology sector as we know it. Regardless of the magnitude of the inventions and discoveries, Xerox was never able to leverage and include these in their products. The main reason for this was the excessive focus of Xerox's top management on the main product (copying machine) and an inability to understand the significance of the in-house inventions that were generated by the separate department. These inventions were then

exploited by other firms, with Steve Jobs famously admitting that key technologies for the Macintosh were invented at Xerox PARC. In fact, the Graphic Interface (and the Mouse), Object Oriented Programming, and computer networks were taken from a presentation Xerox PARC gave to Jobs when Apple was a small-scale startup, interestingly with Xerox's executives forcing the reluctant researchers to give the presentation in the first place (Cringely, 1996), (Chunka, 2012).

From this background, it is easy to understand why tech powerhouses like Google rely on embedded innovation rather than compartmentalizing it in an R+D department. Google mail is one of the examples of this type of innovation coming from the engineering team. The famous 20 % rule (20 % of an engineer's time at Google should be spent on creative new products) was an attempt to follow through with this culture (D'Onofrio, 2015) (Tate, 2013) (Mackinnon, 2007). Yahoo and Microsoft have recently followed in this path (MacMillan & Stone, 2013) (Maarek, 2016), closing their R+D departments and integrating them into the day to day operations. One of the first acts of Steve Jobs upon returning to Apple in the late 90s was to shut down the Advance Technology Group R+D department (CNET, 1997). An imaginative engineering department that can shorten the development cycle is critical for startups that work in an agile fashion (Blank, 2013). In this scenario, the role and contribution of the engineer is pivotal and key to providing innovation and therefore further the advancement of the startup / technology company.

Software Engineers as knowledge workers

To understand the role that engineers play in innovation in the technology sector it is important to characterize them as knowledge workers. The notion of a "knowledge worker"

was originally introduced in the 50s by Peter Drucker (Drucker, 1999). This kind of worker is in contraposition to the manual labour worker proposed by the Henry Ford / Taylor methodology that was pervasive in the States during and after the Second world war. Where the manual labourer follows a series of steps algorithmically in the fastest possible manner, the knowledge worker is required to ask deeper questions while resolving his or her job, requiring a deeper understanding of his/her profession and the context in which this takes place (Drucker, 1999).

The knowledge worker (Drucker, 1999):

- Asks herself, "What is the task?" rather than "How should the task be done?"
- Has larger autonomy.
- Relies of continue innovation and continuous learning.
- Considers quality as important as quantity.
- Is viewed by the management as an asset, rather than a cost.

Another aspect worth noting for the knowledge worker is the demise of collective and unionized bargain in favour of individualistic, idiosyncratic and personalized employment arrangements (Cullinane & Dundon, 2006).

Engineering falls in a category that Drucker calls Technologist, a group of knowledge workers that apply their knowledge to some sort of applied manual work (Drucker, 1999), bridging logic with creativity. Many of today's highest potential businesses are knowledge -based businesses, especially in the technology industry. "Innovation and the ability to apply technological process is key for future success." (Zelles, 2015), with engineers at the

forefront of this process needing to be able to act tactically (i.e. as planned) or adaptively (i.e. creatively) to ensure stability of the tech firm (Doshi & McGregor, 2015).

Cost of Engineering

The cost of developers is one of the main expenses in Tech firms. For example, it is above > 30% of costs at Facebook and increasing (Trefis, 2016). This is true despite the pressure in technology to do more with less, especially following the dot-com bust of 2001 and the great recession started in 2008 (Moquin & Riemenschneider, 2014).

This generates different trends in the tech engineering profession. The first is a lack of stability in general (Moquin & Riemenschneider, 2014), accompanied with a continuous push to learn new skills, technologies and stacks to remain in the top percentile and be able to perform at startups or Extreme Jobs (Moquin & Riemenschneider, 2014). Extreme jobs are jobs whose demand are very high in terms of hours and effort, typically with the total of hours spent commuting and working totalling to more than half the total day time (Judge & Robbins, 2010, p. 610).

A shortage of engineering talent currently exists in the markets where startup real expertise resides, mainly in some pockets of the East and West coasts of the United States, (Blank, 2013). Universities are unable to produce enough Computer Science graduates to fill the market demand (Lerman, 2016), with some predicting one million engineering tech jobs going unfulfilled by 2020 (Microsoft, 2012). This has given rise to a number of phenomenon, from a push to relax the policies on working visas for tech workers (Costa, 2012) to the rise of coding bootcamps and immersive courses to attract talent in the industry

from other professions like other forms of engineering, business and even the arts (Krasny, 2015), (Ravisankar, 2016).

Within this backdrop, tech companies are compelled to offer competitive packages beyond the remuneration and benefits. Tech giants like Google and Apple are perceived as setting the tone in terms of benefits offered to attract and retain the best engineers—providing anything from free lunches (and breakfasts, and dinners), oil changes, laundry service, haircuts, gourmet food, great locations, wellness centres and superior décor for their offices (Casserly, 2012), (Biggs, 2008) (Lev-Ram, 2014). These benefits were originally aimed at reducing friction and freeing up engineer's time – as Google CEO Eric Smidt seemed to suggest when commenting upon these benefits: "The goal is to strip away everything that gets in our employees' way" (Pattanyak, 2014). Following the example of the most prominent firms, many tech companies and startups offer these benefits as well. These are currently so pervasive in the industry that some can be considered hygiene factors (i.e. to prevent dissatisfaction), rather than motivating factors (Herzberg, 1964).

Figure 1 : Google office, San Francisco (Dunlop, 2011)

This scenario contributes to increasing the costs for recruiting the engineering talent required for a tech firm, making the hiring market very favourable for candidates (Lerman, 2016) and leaving tech companies trying hard to project culture and benefits to attract millennial works.

Finding the right fit

Regardless of the cost (in terms of salary and benefits) of attracting engineers, there is by no means a one-size-fits-all in terms of what makes a successful engineer, and success may not translate across firms. For example, an engineer that is suitable for Facebook may not be successful for Google, and vice versa. In addition, Google and AT&T showed quantitatively that aspects like superior academic performance is not a predictor for performance on the job (Davenport, Harris, & Shapiro, 2010). Google also reported that solving brain teasers at the interview step (NPR, 2004), a practice they borrowed from high calibre consulting firms, is not a predictor of performance (it is “a complete waste of time”) (Konnikova, 2013).

AT&T and Google reported that proactiveness and the ability to take initiative is a much better predictor for performance on the job (Davenport, Harris, & Shapiro, 2010), with recruiting firms even suggesting no correlation between even having a CS degree and your performance as a developer (Mims, 2015).

Motivation

Look Beyond Money

It has been quantitatively proven that increasing monetary benefits does not lead to superior performance for knowledge workers. Monetary incentives provide superior performance on algorithmically repetitive jobs, but an inverse correlation between financial incentives and performance exists in the case of activities that include cognitive skills (Kohn, 1993), (Ariely, Gneezy, Lowenstein, & Mazar, 2009), with the London School of Economics quoting that "the provision of incentives can result in a negative impact on overall performance" (LSE, 2009). For jobs with a creative content, money is therefore a hygiene factor in Herzberg terms, something to be addressed enough to be taken "off the table" before the negotiation (Herzberg, 1964) (Pink, 2011, p. 170).

Monetary motivation may be counterproductive and incentivize the wrong behaviour, even in less creative professions. For example, financial incentives connected with the average length of calls in a call centre drove staff to drop calls as soon as answered when their average time was getting closer to the limit (Doshi & McGregor, 2015), or lead to unethical behaviours like those highlighted in the recent scandals at Wells Fargo bank or at the Atlanta Public School district (Holman, 2016) (Bowers, WIlson, & Hide, 2011).

This evidence shows how extrinsic motivation factors either at the organizational (e.g. profit sharing) or at individual level (e.g. pay increase) (Bratton, 2015, p. 193) have limited scope in improving employees' performances. Intrinsic motivational factors, either at the individual level or organizational level, are instead credited for superior performances for knowledge workers. For example, Zelles conducted a longitudinal study showing how knowledge workers are especially affected by intangible and non-financial motivations (Zelles, 2015), with employees' engagement correlating positively to higher profiles.

As an additional evidence, it has been shown that workers in Extreme Jobs—i.e. those with high demands in terms of hours and effort—are not motivated by pay but rather by the "rush they get from doing stimulating or challenging work", even to the point of allowing that to affect their relationships or ability to maintain a home (Judge & Robbins, 2010, p. 611) (Hewlett & Luce, 2006)

Theories of motivation

The study of motivation has attracted interest since the middle of the past century, with different theories proposed and tested. Different definitions of motivation exist, with Judge et al. proposing: "*The processes that account for an individual's intensity, direction and persistence of effort toward attaining a goal*" (Judge & Robbins, 2010). Different aspects influence motivation.

Two main categories exist for theories of motivation: 1) Content-based and 2) Process-based (Huczynski & Buchanan, 2013, p. 285). Content theories concentrate on individual needs and goals, and how a human pursues the fulfilment of such needs. Process theories on the other side are more concerned with how the motivation and the activity occurs.

An example of content theory of motivation is the influential Maslow's hierarchy of needs (Maslow, 1943).

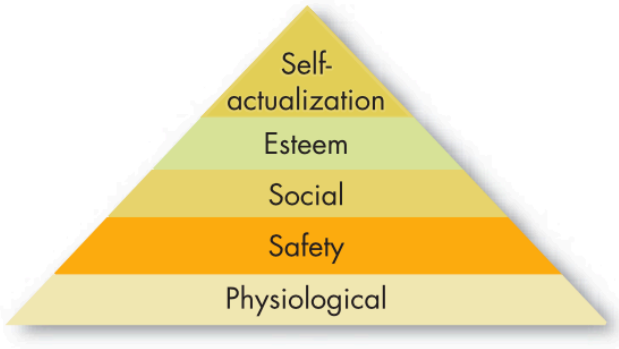

Figure 2 : Maslow Pyramid of needs (Judge & Robbins, 2010)

Maslow theorized that different human needs can be thought of as grouped and stacked in a pyramid from the lower levels of physiological needs such as food and shelter, to safety, social, self-esteem and finally self-actualization. Humans try to fulfil each level and, once done with that level, they jump to the higher one. In Maslow's view, deficiency of the most basic (lower) aspect motivates action. Maslow's pyramid of needs has been criticized for its lack of empirical supporting study and for the difficulty of use for practitioner, as using it to motivate requires knowing where in the path the subject is. Nonetheless, it remains one of the most important theories for reasoning about motivation.

Alderfer refactored and expanded on Maslow's theory, characterizing the needs into different groups: Existence, Relatedness and Growth (ERG theory) (Alderfer, 1969), adding the perspective of a continuum rather than of a discrete hierarchy with steps. Importantly, Alderfer contributed to the discourse asserting that other motivation methods exist beyond mere deprivation.

Herzberg's studied motivation for Accountants and Engineers, leading to the formulation of the two-factor motivation theory (also known as motivation-hygiene theory) (Herzberg, 1969) in which he asserts that two classes of factors need to be taken into consideration to understand job performance: hygiene and motivating factors. The factors that prevent job dissatisfaction belong in the former category, while the latter comprises the factors that allow superior performance.

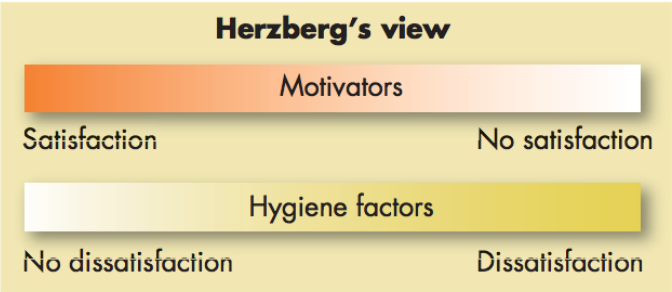

Figure 3: Herzberg two factors theory (Judge & Robbins, 2010).

An example of the hygiene factors would be appropriate pay and decent working conditions, while an example of motivation factors would be recognition and a sense of achievement. Like Aldeber, Herzberg introduced a continuum rather than a punctuated framework: the hygiene factors contribute to put the employee between satisfaction and no dissatisfaction, while motivation factors can raise the employee from no motivation to motivation (Judge & Robbins, 2010, p. 205). Following his interviews with engineers and accountants, Herzberg also introduced aspects such as job enlargement, rotation and enrichment as motivational tools. As per Maslow's theory, Herzberg's theory has been criticized for lack of empirical proof but nonetheless it remains a very useful framework.

McGregor as well contributed to the content theories of motivation with the Theory X and Theory Y (McGregor, 1960). These two categories of motivation are that managers

subscribing to Theory X having a Tayloristic view of work and therefore valuing close supervision, coercion and penalties to ensure employees would do their job. While managers subscribing to Theory Y would be instead more progressive and rely more on job satisfaction, encouraging workers to take initiative and start tasks without necessarily direct supervision. Noting the previous discussion, knowledge workers in the tech industry fall into the second category.

Vroom's expectancy theory is an example of process theory of motivation (Vroom, 1964). This theory assumes humans as rational actors whose choice to act relates to the beliefs (expectation) that a certain current behaviour will lead to a certain future outcome. In the specific, motivation can be measured as the product of three factors: A) desirability of the perceived outcomes, b) belief that performing a certain act with result in an expected outcome and C) capability of performing said act.

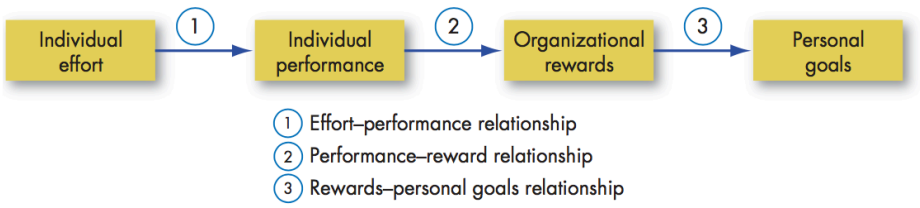

Figure 4: Expectancy Theory (Judge & Robbins, 2010).

Vroom's theory is of importance considering the emergent R+D movement in the tech sector. It has been shown that tendency of employees in entertaining proactive innovative behaviours can be framed through the expectancy theory, as failing to achieve expectation of success would prevent innovative behaviour (Morrison & Phelps, 1999). It has been empirically shown that so-called proactive behaviours are affected both by contextual

aspects (e.g. top management opened) and by motivational variables (e.g. self-efficacy and felt responsibility) (Morrison & Phelps, 1999).

Adams proposed another process theory, the equity theory (Adams, 1965), which focuses on the perception of fairness in treatment by the employee. In this view, the employees' actions are motivated by maintaining the fairness and balance in terms of relationship with the employer and with the other workers. This theory will inform out discussion about the psychological contract.

Locke's goal theory (Locke, 1968) focuses as well on the process, specifically on the cognitive process of goal setting and that being a motivational tool for superior employee performance. Many firms involve management by objective initiatives (or appraisals, or OKRs), which leverage Locke's theory to improve motivation. Manage by objective initiative has not always been successful, in some cases due to lack of commitment by top management or unrealistic expectations (Judge & Robbins, 2010, p. 214).

Of particular interest in the Engineering profession in the Tech industry is the Self-Efficacy theory, which refers to "*an individual's belief that he or she is capable of performing a task*" (Judge & Robbins, 2010, p. 215). In adverse situations employees with high self-efficacy tend to stick to the task, try harder to achieve mastery and, eventually, deliver. This in turn brings a raise in self efficacy, therefore causing a positive spiral. Self-efficacy is often paired with and complemented by the goal setting theory. Setting high goals tends to communicate superior trust in a staff member, in turn raising their self-efficacy.

Regardless of the motivation that can be exerted, it seems like managers and recruiters are aware of the motivating effects, and "don't want people to be here because [we] convinced them" (Lerman, 2016) but rather include culture fit and motivation (Littlewood, 2012) (Kawasaki, 2006), as well as interest in solving large scale problems as a correlation with the best engineers.

Daniel Pink also proposes a framework for looking at motivation beyond the monetary gratification. In his views the motivation factors that drive superior performances are autonomy, mastery and purpose (Pink, 2011). Bringing many examples from the software industry, Pink showed how these three aspects motivated the engineers behind businesses like Atlassian, and services like the operating software Linux and the information service Wikipedia. The importance of meaning in one's job is also highlighted in the work of Laszo Bock (Google's chief of HR) (Bock, 2015), especially as it relates to the engineering profession and the use of creativity and logic at the same time. The importance of purpose is recognized in academic studies of motivational factors in less creative professions such as janitorial staff in hospitals (Rosso, Dekas, & Wrzesniewski, 2010) as well as the importance of play and culture in the total motivation (Doshi & McGregor, 2015).

Psychological contract

Of interest in terms of staff retention is the concept of the psychological contract (PC). This is an unwritten arrangement between the employer and the employee, developed over time, that states and sets out the mutual expectations (Judge & Robbins, 2010, p. 278). The PC was first stipulated in the 60s, but did not attract much attention up to the early nineties with the work of Rousseau.

> *Levinson et al. (1962, 21) saw the psychological contract as 'a series of mutual expectations of which the parties to the relationship may not themselves be dimly aware but which nonetheless govern their relationship to each other. […] managing people at work is portrayed as containing a strong social dynamic, rather than a purely static and one-off economic transaction.' (Cullinane & Dundon, 2006)*

The PC is not necessarily a contract in the legal sense of the concept, but rather a construct (Rousseau, 1998) made of ongoing social exchange interactions between the employee, the employer and the job market. It is made of multiple messages received from the management and from the outside environment about the expectations and obligations in a position. It is not negotiated, but rather formed organically over time, with processes like appraisals helping to formalize and frame the discussion (Herriot & Pemberton, 1997), as well as preventing misunderstandings between management and employee (Cullinane & Dundon, 2006).

Setting and communicating the organizational culture plays a pivotal role in the PC discourse (Guest & Conway, 2002) (Herriot & Pemberton, 1997), with the myriad of social exchanges that generate organizational culture informing as well the PC (Guest & Conway, 2002). Expanding on the construct view for the PC, Rousseau calls the zone of acceptance the "perceived variety of behaviours that one party will accept from another party without question" (Rousseau, 1995) (Schalk & Roe, 2007). The positive effect of relational PC on "levels of commitment to the organization, job satisfaction, and intention to stay" (Guest, 2004) has been proven in (Kalleberg & Rogues, 2000)

The organization and the employee are not the only parties contributing to the PC: the prevailing conditions of the job market may also contribute and inform the PC. For example, Google offering laundry services and catered high quality meals would push other tech companies to offer similar conditions to their engineers, or otherwise risking lowering motivation due to failure to meet the equity theory, even though this part of the PC came from an external actor (Guest & Conway, 2002), (Herriot & Pemberton, 1997) (Stiles, Gratton, Truss, Hope-Hailey, & McGovern, 1997).

It should also be noted that the PC starts to form before the formal employment contract starts: PC is constructed starting from the recruitment stage (Robinson & Morrison, 2000), and continues through the job relationship. The recruitment stage has been recognized to be pivotal in the formation of the PC, while top down communication being less important (Guest & Conway, 2002) in terms of correlation with fewer breaches for the PC.

Rousseau (Rousseau, 1995) centres the psychological contract on the employee and his/her expectation. Guest expanded the concept of PC including the employer point of view as well and its expectations, on top of those of the employee, asserting that this is a two-way exchange, unless the power differential is large, therefore not allowing the employee to have his/her expectations (Cullinane & Dundon, 2006).

Failure of the employer to meet the expectation would qualify as a breach of the PC, with unmet expectation causing decrease of motivation and performance. In Herzberg terms, violation of the PC would be a hygiene factor violation (Herzberg, 1969). Violation of the PC may raise feelings of “anger, distress, injustice, and mistrust”, usually arising either form a single event or from a series of events that give the employee the realization that

“one's organization has failed to fulfil its obligation” (Robinson & Morrison, 2000) (Moquin & Riemenschneider, 2014).

It has been registered widely that breaches of PC increase levels of neglect and lead to deterioration of work conditions and lower levels of obligation (Ng, Feldman, & Lam, 2010) (Lemire & Rouillard, 2005) (Turnley & Feldman, 1999) (Rusbult, Farrell, Rogers, & & Mainous, 1988), even in very long time periods such as two years as in (Robinson, Kraatz, & Rousseau, 1994). PC Breach will reduce the affective commitment and reduce the impulse to innovative behaviours, therefore leaving the employee only performing the minimal tasks required for continuous employment (Ng, Feldman, & Lam, 2010) (Riketta, 2002), and leading to an increase in turnover over a longer timeframe (Bentein, Vandenberg, Vandenberghe, & Stinglhamber, 2005).

Several aspects contributed to the rise in the importance of the PC for knowledge workers (Allvin & & Sverke, 2000) (Guest, 2004):

- Smaller workers’ footprint that has been seen with the advent of the knowledge worker.
- Increasing job fragmentation.
- The urgency of change (especially important in tech).
- The growing interest in work life balance.
- Decreasing number of workers covered by systems of consultations and negotiations.
- Growth of neo-liberalism and American form of individualism.

- Idiosyncratic forms of employment introducing a large amount of complexity, with greater scope for breach, violation and the risk of unfairness and bias (Guest, 2004).

In some cases, the employer or the management may be unable to fulfil its obligation to the employee due to external forces and therefore need to renege the promise made (Robinson & Morrison, 2000). Regardless, a change of management expectations is still likely to be viewed simply as a breach of PC by staff, disregarding the control management may have on the matter (Guest & Conway, 2002), unless this is mediated by open and frank communication.

It should also be noted that the appreciation for a job contains a strong longitudinal component, and it is composed by an aggregation of emotions and judgements (affective events theory) (Weiss & Cropanzano, 1996) (Ng, Feldman, & Lam, 2010).

Engaged and Angry workers.

Multiple studies have been produced on 'exemplary cases' of culture-led, high-tech companies performing well (Kunda, 1992), for example at Sysco: "Sysco's analysis revealed that operating units with highly satisfied employees have higher revenues, lower costs, greater employee retention, and superior customer loyalty." (Davenport, Harris, & Shapiro, 2010). Certain companies are trying to gather some analytics from their own employees to show how the firm is doing in the first place, e.g. Jet Blue is now pooling net promoter score for their own employees to gauge engagement (Davenport, Harris, & Shapiro, 2010), while Sysco uses proxies such as the contribution to blogs and social media to assess engagement. A study at Cognizant, a US based consulting tech firm, showed that engaged and satisfied engineers "performed about 10% better, on average" (Davenport,

Harris, & Shapiro, 2010). The engagement was analysed looking at social media contribution and blogs as proxies. Analytics work in reverse as well, with examples like Sprint attempting to predict if and when a resource would leave (Davenport, Harris, & Shapiro, 2010).

In this study, we will assume engagement as:

> *"[…] a positive, fulfilling, work-related state of mind that is characterized by vigour, dedication, and absorption. Rather than a momentary and specific state, employee engagement refers to a more persistent and pervasive affective-cognitive state that is not focused on any particular object, event, individual, or behaviour." (Zelles, 2015)*

Other tools that are used to increase engagement are management by objective, appraisal, or OKR (Objectives and Key Results), mostly leveraging process theories of motivation. Interestingly, OKRs were first introduced in an historical tech firm: Intel (Bock, 2015). The common theme along these measures is to realize that after hiring an employee, an effort must be made to improve his/her performance in the first place, rather than seeing them go (Davenport, Harris, & Shapiro, 2010).

Cushen and Thompson conducted a longitudinal study which showed some results dissonant with the engaged to productive workers correlation. They worked in the Irish office of a large – top tier tech firm, with a very strong culture emanated from the management. Their work showed that, contrary to the common belief, angry workers that are motivated by extrinsic motivations such as working with the latest technologies can

still be high performing (Cushen & Thompson, 2012). Their research highlighted how engineers, thanks to their position, could easily identify misalignments between the culture that the management was proposing and the actual culture. Employees (mostly engineers) were affected by insecurity rather than financial consideration per se. In many cases engineers were aware of being under paid, but they worked hard nonetheless, and achieved great results, mostly motivated by the mastery of the work they were doing, resonating with Pink's views (Pink, 2011).

> *"In terms of work quality, employees appreciated the opportunities to work with leading technologies and produce 'good' work. As one employee stated, 'If you're looking to work with the latest and best [Technology] come to [this company]'." (Cushen & Thompson, 2012)*

Research Questions

Engagement

The literature analysis and a review of the current trends in the technology sector shows that engineers' engagement is an important aspect of ensuring innovation and superior performance for tech firms (Zelles, 2015), especially moving away from the R+D departments pattern. Furthermore, engagement can be used as a bellwether for resources considering leaving, or ensuing breaches to the psychological contract (Robinson & Morrison, 2000).

While some firms actively manage engagement (Davenport, Harris, & Shapiro, 2010) (Ng, Feldman, & Lam, 2010), it is unclear if this is *widespread* across tech firms and startups.

Blog entries and participation to social media are one way to assess engagement, but in general there does not seem to be a wide selection of methodologies to assess engagement.

There also seems to be a correlation between measures such as OKRs, goal setting and/or appraisal and engagement / motivation. It should also be noted that engineers generally "hate being micromanaged on the technical side, but love being closely managed on the career side". (Garvin, 2013). The penetration of these measures and their use to assess engagement in technology is unclear.

RQ1 - How do tech firms seek and actively measure engagement from their engineers?

Engineering managers and the psychological contract

Breach and recognized violation of the psychological contract lead to dissatisfaction and resources leaving the firm. As we have seen, the psychological contract is generated organically during the employment relationship, starting extremely early in the recruiting phase. The first step to prevent incongruence is to ensure that the employee's view and understanding is aligned as much as possible with the employer's / management's view and understanding. Engineering managers play a central role in this environment as they are involved starting from the recruiting effort onward.

It is unclear if tech firms develop a unique schema to inform what it means for an engineer to be successful (Schein & Van Maanen, 1979). Companies like Google seem to have this aspect more clearly identified, but it is unclear if this is common practice across the industry. Beyond encouraging innovative behaviours (Parker, Williams, & Turner, 2006),

a clear definition for this schema would greatly reduce the risk of ensuing PC incongruence later in the employment relationship (Robinson & Morrison, 2000).

In addition to the schema definition, it is also unclear if hiring managers explicitly take care to use a single voice and convey a single message during the selection process and the socialization to manage the perception and expectations of the prospective employee (Guest & Conway, 2002). There is a mild to strong correlation between the interview and the performance (Bock, 2015), making this step critical for PC on both the employee and the employer side.

For example, it is common practice to have current engineers conducting part of the interview process for prospective candidates (Bock, 2015). Engineers are usually not HR practitioners, but nonetheless represent the firm in a critical process for the definition of Psychological Contract. It is unclear if they are briefed or instructed about non-technical questions that candidates may ask.

RQ2 – How do engineering managers maintain and manage software engineers' expectations?

Methodology

The research methodology chosen was that of semi-structured interviews with engineering managers in the tech industry on the West Coast of the United States. Different factors influenced the methodology selection. An analysis of the literature review showed a lack of deep information concerning the specific target area and target subject. Information is available for the subject of psychological contract and engagement, but a large part of the specific area of interest is uncharted. The hypotheses formulated during the preparation were somewhat too broad in scope to facilitate an inductive reasoning of outcomes rather than restricting to a narrow facet with deductive line of reasoning (Saunders, Lewis, & Thornhill, 2012, p. 145). The interviewer and author is a practicing engineer in the tech industry, and has had experience in project management. It was perceived as beneficial for the outcome to allow the experience to inform the interview process and allow the level of exploration that a semi-structured interview strategy can offer.

Considering the definition of qualitative interview proposed (Fontana & Frey, 2000) as a "negotiated accomplishment shaped by the social and cultural context of the interview", a structured interview would have prevented exploring the cultural context aspect in depth due to the negotiation. A preliminary consultation with HR practitioners in the tech industry confirm this approach to be valid (note that these professionals were not interviewed during the primary research portion).

The literature as well confirms that qualitative methodology can be successful for IS research, but the potential pitfalls of this approach were analysed (Myers & Newman, 2007) (Fontana & Frey, 2000). The target subjects for the study were engineering managers

and CTOs that directly manage engineers (note that this is common in the tech industry) mainly on the West Coast of the USA. They are therefore practitioners that are at the front line of technology implementation and have a continuous access to developers. This group was targeted to access data directly, noting the importance of interviewing practitioners directly for an inductive study (Talet & Al-Wahaishi, 2011). This sample selection minimizes as well the "elite bias" (Myers & Newman, 2007), which consists of the bias resulting from interviewing only people with high status or only intermittently in touch with the actual phenomenon (e.g. CEOs or recruiters) (Miles & Huberman, 1994). Recruiters and HR practitioners would provide interesting perspective, but for the scope of this study it was preferred to focus on the selected group.

For the most part the subjects were not direct acquaintances of the author, but rather contacted from the extended personal network of the writer or via LinkedIn. This was to limit the possible "lack of trust" pitfall that semi-structured interviews may present (Myers & Newman, 2007). The "level of entry" pitfall may arise when the first subjects interviewed are lower in the firm's organization, "for example, if a researcher enters at a lower level, it may prove difficult if not impossible to interview senior managers at a later date" (Myers & Newman, 2007). The tech industry, especially in the West Coast, usually presents extremely flat organizations. Also, the study is not focused on a single organization but rather spanning different organizations, therefore this risk was perceived as mitigated.

During the data gathering process of semi-structured interviews the interviewer, alongside gaining knowledge on a subject, is as well constructing knowledge (Saunders, Lewis, &

Thornhill, 2012, p. 146). In turn, the interviewed subject may do the same while talking to the interviewer, especially as interviewed people want to appear knowledgeable and expert in their field (Myers & Newman, 2007). The constructive knowledge bias is somewhat inextricably woven into an inductive semi structured process, but to minimize the effect on the research the interviewer prepared the literature review, the methodology, and has conducted semi-structured interviews in the tech sector for a previous research initiative. In addition, to tackle the constructive knowledge bias and to increase the professional image of the research (also to project a professional image for the interviewer), the companies where the subjects work were reviewed beforehand.

As the subject of the study does not comprise commercial or deep technology details where tech firms may be more attentive to confidentiality, and is instead a subject where large tech firms are recently showing a very high level of transparency (e.g. Google and its HR head Laszo Bock), the risk of deceptive behaviour at the interview was perceived as low (Myers & Newman, 2007). Also, as the interviewer is a tech practitioner, the risk of "ambiguity of language" was perceived as minimal, but addressed in the questionnaire opening remarks nonetheless. Where possible, the interviews were conducted face to face. Otherwise the interview would be over telephone or screen sharing (Google Hangout, Skype or similar).

To provide the subjects with the possibility to decide upon their participation, their interest was gauged via email rather than by phone or other means, with a clear explanation of the context, purpose and subject of the interview was provided.

The script for the full interview, comprising the questionnaire as well as the opening, introduction, and closing remarks (Myers & Newman, 2007), was prepared during the study's design phase. Space was left to improvisation nonetheless, especially as the interviewer is a practitioner in the tech industry. This allowed a reduction of social dissonance between the interviewer and the subjects, and also reduced the risk of failing at first impression (Myers & Newman, 2007)

The interview's script included a disclaimer part where the subject was reminded about the context of the study, its confidential nature and her rights to terminate at any time. The questions for the data gathering section of the interview were grouped around the hypothesis proposed (please refer to the appendix for details).

The robust disclaimer part was introduced via the questionnaire, where the subject to be interviewed was advised very clearly about the interviewer's role as a researcher and not as practitioner from another tech firm, to improve the openness of the conversation. Even though the interviewee was already aware of most of these details, including this part upfront primed the subject on the interviewer's role and on the required level of clarity.

Notes were taken during each interview. Notes were taken on paper, rather than on a laptop, to reduce the barrier across the interviewer and the subject (the vertical laptop screen). The audio of each interview was recorded as well.

Analysis phase

The analysis phase of the study was not started until the interview phase was fully concluded, to avoid biasing the last interviews. The audio of all interviews was listened to

individually. While each interview was not fully transcribed, an individual notes document was compiled for each recorded interview. This document comprised the themes and main answers that the subject gave for the two research questions. Even though notes were taken during the interviews by the author, the researcher decided to listen again to the full audio to make sure all aspects and nuances of the answers were captured.

Each interview note was then analysed independently. During this phase the answers and themes discussed in each interview were organized and grouped by subject, then extracted and copied to into a single aggregation document. The aggregation document had two parts (one for each research question) as well as sub-headers relevant to the sub-themes that emerged. For example, for Research Question 1 one of the themes was engagement and productivity. This was one of the sub headings in the aggregation document. All content from each single interview relevant to engagement and productivity was aggregated under this heading. The aggregation document and its sections were then studied for common patterns across multiple interviews.

Interview questions

The questionnaire (refer to attachment) opened with disclaimer and a few general questions to position the subject's demographics and activity within the industry. The questions on RQ 1 (engagement) were asked after this introduction, and questions for RQ 2 (psychological contract) were asked afterwards. For both sessions, questions were kept as open as possible to favour the inductive nature of the semi-structured interview approach and the exploratory spirit of this study (Saunders, Lewis, & Thornhill, 2012, p. 377). This also means that in many cases the subject would respond to a specific question and, in his

remarks, would fulfil part of another question. Therefore, the order of questions was not strictly followed during the interviews to favour the subject's flow of thoughts.

The questions for the engagement research question (RQ 1) were aimed at gauging the importance for managers of engineers' engagement, and if/how they manage it. The subject was firstly asked for his definition of engagement, specifically for software engineers. The reason for this is that, as seen in the literature review, the subject of employees' engagement is not clearly defined and to propose an overarching definition to the subjects would have primed and bias the interview, detracting from the inductive nature of the study. The following questions were aimed at understanding the manager's inclination to seek engagement from the engineers, and how they achieve or promote it. Previous studies were used as inspiration for these questions, mostly (Zelles, 2015) and (Robinson & Morrison, 2000).

In terms of the "expectations" research question, (RQ2) the term psychological contract was not mentioned in the interview as the sample did not involve HR practitioners but rather engineering practitioners. For this reason, the first question regarded the non-monetary expectations that managers perceive engineers to hold rather than a definition of psychological contract. In addition, aspects regarding the formation of the PC were asked, including questions regarding the recruiting process (which is a critical aspect of the PC formation). The other key question for this part regarded occurrences of psychological contract violations reported to the manager being interviewed.

Data sample

The primary research phase comprised interviews with twelve managers involved in both tech startups and established companies. Most of them were based in the Pacific Northwest of the United States (greater Seattle area), besides one who was in the Denver / Boulder area. Some of the participants also had professional experience working in Silicon Valley or other areas of the US prior to working in the Pacific Northwest. The interviews took place during November and December 2016 and were all conducted in person, aside from one conducted via video call. The participants were sourced from the writer's extended network, as well as cold contacts via LinkedIn and email. A total of 41 managers overall were contacted for the study from the above sources. Of these, 15 responded. Interviews were organized with 12 people. All engineering managers interviewed were male, and this is unfortunately representative of the tech industry – according to the National Council for Women in Technology, "In 2015, women held 57% of all professional occupations, yet they held only 25% of all computing occupations…furthermore, even fewer women are found in software development, technology leadership, or the other kinds of key roles that have a significant influence on future innovation." (Ashcraft, McLain, & Eger, 2016) The aspect of female participation in tech is outside the scope of this paper.

Even though the participants' official job titles varied all of them had, or had had in their previous positions, at least seven technical direct reports. The overall size and distribution of the teams they managed spanned from eight at a single location to approximately nine hundred across different time zones.

It should be noted that some of the participants managed data scientists rather than software engineers. The two positions differ in terms of the final product, but they both operate in the same environment and relate similarly in terms of qualifications and workflow from a human resource perspective. Therefore, in the scope of this study, they are studied together.

The number reported next to the quotes in the text below does not relate to any specific order (alphabetical or similar) for the managers interviewed.

Findings and analysis

Engagement

In the first part of this analysis on engagement we will discuss the connection between engagement and productivity, and the common ways in which engineering managers define engagement. This analysis will then move on to discussing the key engagement levers most commonly identified through interviews.

Engineering managers appreciate the connection between engagement and productivity.

All the engineering managers interviewed reported a strong correlation between engineers' engagement and their productivity, in accordance with the prevalent literature and in contrast with the notion that angry software engineers can be productive (Cushen & Thompson, 2012). When asked how to define engagement for software engineers, in many cases engineering managers tended to define it via proxies of productivity. In other words, productivity was perceived as an indispensable and mutual condition for engagement.

Managers were by and large cognizant that "*different individuals show engagement in different manners*" (EM #1), but certain traits emerged across the spectrum.

The most mentioned benefits and traits that were associated with engaged software engineers were:

- They have higher velocity in adding functionality to the code base / they introduce fewer bugs. There is a correlation between engagement and productivity, as for software engineers coding and development is an *"art and a craft"* (EM #5). This

seems especially prominent when engineers are working on the functionality that provides an experience or solves a problem for the customer / user.

> *"Some engineers just like to come in and crush bugs, […] but there are others that are more interested in ship functionality and provide experience to people. [The latters'] productivity is tied to engagement, for the first one it does not really matter what they are working on." (EM #4).*

> *"Engaged engineers help move functionality along faster" (EM #5)*

- They are connected either with the product mission, with the brand or with the technology that is employed. This is closely related to the previous point, as engineers will engage and move functionality along for challenges that resonate with them, or if they are using cutting edge technology.

> *"Allow [the engineers] to work on the coolest technologies possible, and engage the customer with the engineers [rather than with sales people]. This gives them a sense of pride, that they are proving something to the industry." (EM 3)*

> *"even though our product did not contribute to solving large humanitarian issues, I could map my work with a customer…she told me she loved our site as it saved time for her, and she could spend more of it with her kids instead" (EM #9)*

- Engaged engineers also don't focus solely on delivering the task at hand or the user story as specified by others, but rather improve upon the design and provide extra

functionalities. As engineers tend to be in direct contact with the final users and customers (more on this later), as part of their activity inevitably involves reactive work to fix bugs / trouble shooting in production. This means that engaged, productive, and aware engineers can provide an invaluable prospective for the development of the product.

> *"Someone who is engaged identifies [tasks] that are not identified and planned for, cares about them and makes sure that they got solved at the right time. Someone that is not engaged will completely ignore them, will only do what is assigned to them. […] For as specific as a specification can be, there will always be unforeseen corner cases." (EM 1)*

- Closely connected with the previous finding, engaged engineers don't require a well-formed specification to work on, but rather can make decisions in the interest of the final customer even in presence of ambiguity and / or lack of specification. On the other hand, unengaged engineers tend to require a complete prescriptive specification for work items, which is normally very time consuming to prepare and prone to unforeseen edge cases that may come up at development or test time. Not requiring a prescriptive specification but rather proceeding on the base functionality (or even better, the problem that needs to be solved) relieves pressure and frees up time for the product design team in the first place. Critical to achieve this it to give engineers visibility into the customers' needs, motivation and normal use for the application / product. Engaged engineers normally seek this, together with a relationship with the product team that allows this dynamic.

"The most successful engineers are those that can wear multiple hats and are not waiting for a Product Manager to come up with a user story" (EM #9)

"Every Friday afternoon everybody on the team had to [log into the platform] and interact with the customer. From the lowest level tester to the most senior person on the team, everybody needed to be on line, taking feedback, learning [from the customer]" (EM #3)

- Engaged engineers also tend to raise the bar for the team around them, enticing the rest of the team around them to "keep up" with their development and innovation, in a healthy form of competition.

"Hopefully, positive competition with your peers on what you deliver. That in itself is a motivating factor, to understand that you need to be engaged to execute." (EM #2)

The engineering managers interviewed acknowledged that unengaged engineers can still be productive and deliver features, but this is usually due to the domain knowledge that they have accumulated over time on a certain product. Engineers can also be unengaged and productive if they have some potential that can be unlocked. *"I have worked in the past with engineers that are super productive but don't seem that engaged and [in some cases] it is because they were not stretched enough, or they were too stretched, or they did not connect with the product." (EM #7).*

Also, unengaged engineers tend to show a much higher reliance on clearly well specified feature definitions, therefore increasing the work load on the rest of the team. One manager mentioned that unengaged engineers can still be innovative, but the lack of contact with the customer that usually is accompanied is very likely to deem the innovation proposed as not useful.

> *"I have seen the effects that are the opposite of engaged and productive: in my previous team, where someone would come up with an innovative algorithm and, if you look at the math, this is the cheapest algorithm. But there is a human aspect as well […] and there were things that you would not know if you were not engaged and involved with the customer. So, you can be productive and not engaged, but you will end up producing the wrong stuff." (EM #9)*

Managers define engagement by proxies

The engineering managers interviewed did not show interest in seeking a numerical measure for the level of engagement in their team, as suggested by (Davenport, Harris, & Shapiro, 2010), but rather cited proxies that they can observe to define engineers' engagement. Referring to the previous chapter, measures of productivity (e.g. amount of work done, in the form of feature / points or velocity) or of goal achievement were mentioned as a proxy for engagement.

Among the proxies used to assess engineers' engagement, behaviour in team settings was mentioned by most managers. Specifically, being spontaneously helpful to colleagues, being proactive, displaying good citizenship, avoiding confrontational behaviours, and

offering solutions without being prompted during the daily stand-up meetings (the first meeting in the morning for agile sprint work) were cited multiple times as proxies for engagement. Engineering Managers in the tech industry seem to pay attention to these during team meetings and as well during 1:1 interviews.

> *"You have to be close to the engineers [to assess engagement], you got to be in the trenches, you have to be at the stand ups. You have to be there scoring ideas on a white board, even if you are only a catalyst and you know just enough to be dangerous. Engaged engineers will challenge you [when you propose something]" (EM #7).*

In all cases the subjects interviewed implemented some form of 1:1 with their direct reports, either at weekly or fortnightly. In most cases, managers required their direct reports to have 1:1 meetings with their own reports. While not all managers have, or even seem to desire, a structured way to conduct these meetings, all managers mentioned these as a step to assess engagement and manage expectations for engineers.

The format for the one on one meetings with direct reports seem to depend highly on the team and the manager, with one mentioning wanting to increase frequency to get a more granular pulse of the situation, and another one mentioning diluting them biweekly to increase their relative importance and not dismiss them as "they happen every week anyway".

Managers at both startups and more established firms identified providing a path for potential issues to be raised as a condition to promote engagement. The retrospective

meetings at team levels were identified by most as the first place where issues should arise (a retrospective is a review meeting over the teams' activity over a unit of time, usually spanning one to four weeks).

On the negative side, not having a long-term vision at their current role or for the product they are working on was identified as a sign of disengagement. This may show in different manners such as searching for other jobs, or not thinking about the issue at hand outside the normal working hours.

Engagement Lever 1: Problem solving

Nearly all the managers interviewed identified problem solving as a major motivator for software engineers, with one respondent (a former engineer) comparing engineers to "*problem solving machines" (EM #11)*.

> *"Engineers are engaged when they are trying to solve difficult problems, and they are looking to solve whatever problem is in front of them there. Their mind-set is "I need to do whatever it takes get to the bottom of a problem, issue or design solution" they want to turn loose of it until it's solved. That is actually how I would define engagement." (EM #8)*

Engineers tend to like problem solving to such a level that "*it becomes hard to promote engineers to management positions*" (EM #9), as they don't want to detach from the problem-solving experience. Also worth noticing that most managers interviewed had held engineering positions as well before becoming managers.

One of the key aspects in problem solving is emphasizing the role that autonomy plays in keeping engineers engaged. As one of the managers reported it, to keep engagement up the push needs to be to "*put the engineers in the position to solve problems*" (EM #11). This means approach engineers with problems, rather than with solutions: "*don't ask for a fence, but rather state that we need to keep the dog in the yard*" (EM #11). This push needs to be mediated by the presence of a Project Manager and/or Service Level Agreements to make sure that timing is respected. Involving engineers with the customer is as well another mediating aspect for this (more on this later in this chapter).

Managers showed sensitivity over the difficulty level of problems to give to engineers depending on their experience level. This means provide increasing level of complication to stretch the person's reach, without over extending them out too much. "*give them a challenge that is difficult, but not unsurmountable*" (EM #7).

Two main risks identified by managers were for engineers at the start of their career to get too invested into a solution, and not be able to focus on the larger picture. *"Depending on the engineer, they can delve too far into the topic at hand and overwork the solution for the problem. […] Identifying what is good enough is a very recurring problem" (EM #8).* It should be noted that some managers have specific goals stipulated for these steps, either at personal or at team level.

Problem solving, either at startups or at more established technology companies can lead to burnout. Periods of high intensity are intrinsic and expected from software engineers to solve problems and make progress. If the engineer's activity goes "outside the normal time windows infrequently because they are learning, extending that is fine. However,

prolonged exposure outside the normal windows of hours leads to burnout and disengagement." (EM #5). Nearly one third of the engineering managers displayed sensitivity to prevent burnout for engineers and provide some sort of work life balance to engineers.

Engagement Lever 2: Visibility over customers' or product's or management's agenda

Most managers identified visibility over the business' direction, other "vertical" disciplines and/or the customer as an engagement factor. At a minimum, visibility has a hygiene factor connotation (in Hertzberg's terms) as it allows engineers as knowledge workers to validate what they are working on and engage with it.

> *"Another thing I hear a lot from engineers is that they want to understand what the vision and the strategy is around the product. They'd like to have visibility, buy in and a bit of a voice. If they don't understand what management is doing they feel in a bubble and they become quite cynical". (EM #2)*

A direct uptick in productivity was reported by one of the managers after disclosing the management's direction with the team. Lack of visibility for engineers carries the risk of them "*turning against the management in case of failure*" (EM 5) and negates "the sense of shared ownership, shared mission that is key for engagement. It cannot be a random [task] every day" (EM #3)

In terms of motivation and engagement, lack of visibility makes it harder for engineers to remain engaged and solve the problem proposed.

> *"in that position I could not map the code that I was writing to smiling faces. That resonates with a specific kind of people, [and in general the] disconnect made it harder to keep morale in the team because, even though we knew what we were doing was important, we felt like we were implementing policies because the legal wants you to implement them, and you start feeling like a vendor, commoditized." (EM #9)*

In terms of problem solving, visibility over the customers' needs and / or the management motivations (e.g. accuracy of information for regulatory and financial reasons) was identified as positive contributor to the engineers' capability to solve problems.

In at least four cases managers showed a clear willingness to put the engineers in direct contact with the final customer. Managers also expected engineers to be seeking this, and actively recruited for this attitude. Referencing back to emergent and engineering-based R+D, providing and seeking visibility beyond the immediate boundary conditions of the problem to solve is a cornerstone of the push to abandon separate R+D departments and move to a form of emergent R+D. This was of importance for one of the managers interviewed, who was extremely vocal in support of this model and had experienced a deep misalignment between R+D's activity and actual customer in a position he held previously.

> *"Embedding engineers in R+D is a move that I see more and more. In pure R+D we may have extremely brilliant minds thinking very deeply, maybe all with PhDs, that shoot out these ideas. Then you may have engineers that implement this stuff. Even if that happens to be the right stuff, if they are not engaged with the customer it would suck to be in that team. I was on that*

team for a while, the morale goes down, you don't understand what is the usefulness. You can't be autonomous, you can't be creative, and if you rob that direct line of communication between engineers and customers, engineers start to feel less and less useful. At that point it is commoditized [and not really knowledge worker]." (EM #9)

"I have had experiences with projects that are sales-driven, with sales people coming up with this product that is supposed to open a market. You will have a product that is a hodgepodge of these conversations [between sales and engineering], but usually lacks cohesion, and along the way you have learned a lot about your customer that you cannot apply. […] On the other end of the spectrum, you have longer development structures, you may have engineers in one arm of the organization, scientists in another arm of the organization, you interact much less frequently, the scientist would be very conservative in their approach as they want to find the right model, the engineers just want the next model." (EM #9)

Visibility over the management motivations and priorities was identified as a motivator for engagement even for external vendors, traditionally used in tech for commoditized work. In the tech sector, external engineer vendors are usually employed in less creative roles—for example in supporting legacy systems. Employing a disproportionate number of external vendors was mentioned by a manager as an inhibitor for engagement and innovation on a larger scale. Nonetheless, the same managers could distinctly see an uptick in productivity from those teams after visits from the management – even though on these

visits the managers did not do much more than talking about the management priorities and providing some feedback on demos.

Organizational clarity, in the sense of work organization, was also directly identified by four subjects as an engagement factor for engineers. Specifically, managers pointed out that organization needs to be functional to allow engineers to solve problems. This may take different forms, but having a specific road map with goals for the team to reach was perceived as an engagement and motivation factor. This is a delicate balance. As one of the managers cautioned: products in the Technology sector often are not built with an upfront design as you would expect in other industries (such as, for example, construction). This means that the roadmap is very fluid, while engineers' expectations may be of a set roadmap (especially when they are at the outset of their careers). In terms of organization, smaller companies implement Democratic Anarchy, with managers allowing the team to change and amend the dynamics for the work organization.

Four managers pointed at misalignment between management's messaging and the reality of the product as levers to disengage engineers and promote cynicism. Almost all managers pointed at lack of visibility into the management rationale and goals as direct causes for disengagement, with two managers pointing out that this is more possible during reorganization efforts. Regardless of the reason, due to their proximity to the product, engineers are "in the trenches" and can usually detect misalignments with the management vision and messages very quickly, causing disaffection and cynicism.

Visibility for the engineers' work was as well a motivator. Three managers mentioned recognition opportunities for work delivered as a motivating and engaging factor.

Specifically, after having delivered a feature it is usually easy for development teams to just jump onto the next one straight away. Providing spaces to show these functionalities to the "outside world" was perceived as a motivating factor.

Engagement Lever 3: Autonomy to move into the voids

Engaged engineers, when given visibility over the business / customer and especially when having more experience, tend (and are expected to) move autonomously towards areas where product improvement / development is possible. Managers facilitate this in different ways, either ensuring their direct reports have some stake in tools/verticals that are outside their immediate OR providing engineers with problems. None of the managers interviewed viewed positively the across-the-board 20% time rule for unstructured learning that Google implemented.

Rather, in some cases managers made sure their direct reports had a stake (or even led in the first place) an initiative that is outside their immediate scope to cultivate their vision outside their immediate role. Even larger firms are removing the barrier across vertical silos, for example Microsoft (Marliem, 2016). In other cases, managers would approach engineers with problems and provided longer uninterrupted stretches of time to come up with a prototype to solve that problem. In further cases, part of the engineering budget was dedicated to external projects and allocated to at the discretion of the managers. This method is consistent with the heuristics in the tech industry, for example by HP to invent the thermal ink-jet, where they "increasing motivation and freedom [while] enforcing discipline on the inventors" (Fleming, 2002).

Engagement Lever 4: Skills Growth

Another key theme that most managers mentioned for promoting software engineers' engagement is skills growth. This typically can sit at two levels: either on a technology level (learning new technical skills, new frameworks) or at product level (if the product satisfies their interest).

> *"If can provide [..] 65 % of their work as something interesting and enticing, either from a technology or a problem they have to solve standpoint, they can [deal] with the other 35 % of uninteresting stuff that just has to be done". (EM #3)*

Growth varies dramatically between engineers and also along the trajectory of an engineering career. Considering seniority, three managers identified that engineers tend to be more focused (and motivated) by technology content at the beginning of their career, and often want to change their focus towards product skills later on.

> *"The motivation shifts [away from technology] over the years, but [engineers] want to know that they are growing and being challenged ether in closeness to the product and the impact that has or working with very cool stuff, and at that point they can be more forgiving in terms of the impact." (EM #9)*

Managers had divided opinions on the subject of using goal-setting as engagement tool to promote growth. In two cases, managers were very supportive of goal setting on a longer timeline (one year), citing that as motivator and a tool to manage engineers' expectations. Both these managers worked at larger companies. In another case, a manager used

objectives but was very cognizant of not having a timeline greater than six months for measurable outcomes. In two other cases, managers showed a more critical approach towards goal-setting at personal level, preferring to use data at team level to measure engineers' performance and growth. In both cases, the managers critique of goal-setting was similar to the literature (Judge & Robbins, 2010, p. 228). The main concern was that goal-setting for engineers was hard to do in the first place. Due to the fast-moving nature of startups and the tech industry, either goals needed to be revised very often or they'd become superseded and irrelevant. Otherwise, goals could be written in a very generic manner to ensure they would not become superseded, also making them irrelevant. The overhead of reviewing goals at a greater cadence was viewed as an excessive overhead burden. In these cases, the performance was assessed by either 360 reviews and / or by the 1:1 at a much greater cadence that semi-annually or even quarterly, and performance was assessed against project velocity, even at team level.

Job titles and growth along a set structure were directly mentioned by three managers as proxies to measure growth and engagement, but managers also identified risks in using them. Levels seemed more necessary in larger organization to provide a structure, while startups tend to (but not always) have extremely flat structures. As one manager put it:

> *"[with a level struture] is where you get the most trouble, as it focuses people towards achieving the next level, instead of focusing them towards something that they enjoy, that they find challenging, and getting expertise in the area. It changes the conversation, in a way that causes more harm than good. The goal becomes to be promoted, rather than for example a*

> *technical area where you want your career to grow […] Not having strict titles lends the company to a culture where advice is sought from people that say useful things, rather than who has the architect title".*

When levels are available, remaining for too long at a certain level of the rung can was identified directly by another manager as a proxy for disengagement (or a show of disengagement).

Two managers identified team composition as having a direct influence over engineers' growth (and engagement). We can infer that the mix is related to skills growth as managers seek mentors for junior team members. Specifically, one manager assesses teams' composition by mapping out the distribution of years of experience to make sure a balance is struck between "young enthusiasm" and "adult supervision" to make sure the project does not go off the rails. This tension is recognized as being the driver for the organizational culture one behind the creation of Netscape, the company that brought the browser revolution to the masses in the mid 90s, which mixed Silicon Valley veterans from SGI with "a bunch of wild kids from U of Indiana [that worked at NCIS on Mosaic]" (McCullough, 2014).

> *"I graph my whole team by level, I want to have a nice distribution between people early in their career and [more experienced] folks. I try to land the sharp kid and drop them in the team of veterans, and that raises the whole team up" (EM #3).*

In accordance with the HR literature on team dynamics, most of the managers seemed cognizant of the mix of personalities in each team. One manager reported having a failing team due to having all engineers being introverted. Introducing one engineer with a more extroverted personality changed the dynamic and improved the productivity and growth of the team.

Psychological contract management

Expectations management

The managers interviewed reported very limited cases of Psychological Contract violation. The cases that were reported were mostly following large scale reorganizations at the company level that left engineers not interested in the new scope of the team. In one case, a manager reported a situation of misaligned expectations for an engineer that transferred into his team from another division of a larger organization. The engineer had the expectation of a homogeneous work organization across the whole group, and could not adapt to the different way of managing the workload and the feature implementation in the new team. In this case, the expectations were created elsewhere within a large firm. In one other case, an engineer was interested in technical growth and left a fast growing, product centric, startup to join another group.

In addition, two managers reported successful cases of alleviating burnout for engineers, preventing them from leaving and reengaging them. A key factor in these cases was the presence of paths for the issue to be raised to the management, either at personal level (1:1

meetings) and at team level (e.g. retrospective meetings). These are signs that maintenance of the PC is generally undertaken in tech.

All managers reported holding some form of 1:1 meetings with their direct reports, whether structured or unstructured, at weekly or at least bi-weekly cadence. In addition, most managers implemented additional tools that facilitate PC maintenance, such as being (or appearing to be) as accessible and open as possible, and being physically present at team meetings. One of the managers had to move to a cubicle office to work on confidential projects and mentioned looking forward to moving back into the open space with the engineers he manages. Another manager who holds a position that is very technical as well as managerial identified the action of including younger engineers into his own project reviews as a tool to ensure an open culture where issues can bubble up freely.

It is interesting to note that one manager also introduced recurrent 1:1 meetings at monthly cadence with his skip levels, with the aim of better keeping the pulse of the situation during a period of growth.

Perks, tech sector style

The managers interviewed did not identify hyper-modern, extravagant or playful office locations or out of the ordinary perks such as laundry service or oil changes as motivators for superior performance or motivators for joining a tech firm. Two of the managers reported the impression that engineers at first employment may use these as proxies to gauge and measure their prospective employer, lacking the heuristics they'd have from an employment history. In those cases, managers were cognizant of the need to manage their expectations.

In other words, in Hertzberg's terms, appropriate office location with standard up to date décor is a hygiene factor, and providing extravagant perks is not really perceived as a motivating factor.

> *"The base expectation is comfortable and up-to-date furniture – if I'd walk [for an interview] into a place with 1980s cubicles, I'd walk right out because that tells me something about the company. [Engineers are engaged and interests if] there is something that tells then that the employer cares about their function, [that is] most likely the hardware you are working on being new and current". (EM #5)*

> *"I hear [most of the requests about office décor and looks] come from college graduates […]. More seasoned professionals don't really have these requests. More passionate engineers are less concerned about the extra stuff and more interested [and want to know] that they have an impact, that they are going to grow and be challenged technically and not writing configurations files" (EM #9)*

This suggests that extravagant "spaceship" offices, flamboyant décor or extravagant perks may project the brand image but contribute marginally as motivating factor. On the other hand, access to appropriate technology (e.g. computing power, training) is a greater motivating factor for engineers to be engaged and creative.

Hiring

The hiring process for software engineers, as reported by the managers and as well in the experience of the writer, commonly involves several steps in close contact with a

substantial number of prospective peers and team members. One of the managers reported that an engineer talks to at least eight other members of the engineering team before getting hired (in a team of 30 engineers). The extensive contact with the prospective employer's organization provides multiple data points for expectations to be confirmed or rectified right at the start of the relationship, noting that the psychological contract starts forming well before the official start of the contractual employment relationship.

In terms of the hiring process, the managers interviewed reported briefing with the rest of the interviewing team and the recruiting team before the process starts to coordinate the coverage for the interview process. Answers to questions on culture and organization were not discussed ahead of time and were left to the single engineer. As the level of psychological contract breach has been reported as very low, coordinating in that area does not seem as required in this industry.

As an additional tool to manage and level prospective engineers' expectations, one of the managers reported holding a preliminary interview with candidates after the first screening steps. In this interview the candidate is encourage to ask the engineering managers anything about the position, the culture and other non-technical aspects of the team.

Recruiting is a critical aspect, especially at startups. One of the managers at a startup mentioned recruiting as a criticality for scaling in the near future, and is addressing the situation by organizing interview training and a shadowing system for a wider pool of engineers to be included in the hiring effort.

Conclusions

The technology industry in the United States has seen a gradual but sustained push away from a traditional model in which innovation and product development is undertaken in Research and Development centres separate from the production pipeline, as it is instead the custom in the manufacturing industry. In the technology sector the model is to blend engineering and product development with incremental emergent innovation, generated from the operations team. This is a mega trend for this industry, and it is historically intrinsic with the hacker culture of the first MIT hackers in the sixties, of the personal computer revolution started by the Homebrew Computer Club in San Francisco in the seventies, the failure of the Xerox Parc in the eighties, the creation of the first browser by a team at NCIS in the nineties, the introduction of the Agile methodology in the early twentieth century. It is currently culminating in Amazon's "customer obsession" at all levels, and the abandonment of the separate R+D model by Nadella's Microsoft (MacMillan & Stone, 2013), (Maarek, 2016), (Sullivan, 2014), (Dua, 2016), (Levy, 2010, pp. 201-227).

Software engineers and data scientists have a primary role in this product development model (Doshi & McGregor, 2015). One of the manifestations of this aspect is the increasing relative cost that engineering presents for tech firms, and in recent economic conditions the difficulty to attract and retain talent (Moquin & Riemenschneider, 2014), (Lerman, 2016).

This study reviewed the background of the tech sector and contextualised the position of software engineers as knowledge workers. The prevailing literature about motivation, engagement and its effect on productivity is reviewed. The monetary aspect has been

reviewed as well, but studies have been presented to confirm that financial gratification is a hygiene factor, not a motivation factor for highly creative positions such as that of software engineers (Herzberg, 1964) (Pink, 2011, p. 170). The concept of the psychological contract, its formation in the employment relationship and its role in talent retention has been reviewed.

The literature review informed the two research questions that this paper attempted at answering. The first research question consisted in understanding the effect that engagement has on productivity and creativity, and if and how that is measured and managed. The second research question delved in the aspect of expectations and psychological contract, to uncover how the psychological contract is managed in the tech industry.

While the literature presented background for the research questions, it was apparent that all the data was not pertinent to the tech sector. Even when IT was analysed, it was usually in the context of firms that have objectives different than software, where IT is a cost centre rather than a revenue generation activity. For this reason, the primary research was exploratory, of inductive nature. Engineering managers with substantial experience in the tech industry were approached and interviewed. Managers were targeted for this first initial study as it was perceived they are in a privileged position with visibility over a larger spectrum vertically, having contacts or being in the C suite, and as well longitudinally, thanks to their longer tenure. The primary data consisted in a series of twelve semi structured interviews with engineering managers, mostly in the Seattle area of the United States.

In terms of engagement, it was observed that all engineering managers interviewed saw a positive correlation between engagement and productivity, and sought engagement for their reports. This is in accordance with content motivation theories such as McGregor's Theory Y or Hertzberg's Motivators factors. Per the engineering managers interviewed, the main benefits that engaged engineers bring is higher velocity / lower bug rates, but connected to the theme of emergent product development, engaged engineers tend not to focus solely on what is on the task's specification that is given to them, but rather extend on that specification. This also means reduced overhead, as that specification does not need to be as rigorous and prescriptive, relieving pressure form the Product Manager role. To do this successfully and produce functionalities that are well-received and that actually expand the addressable market, engineers need to have visibility over the final customers' need, wants and use cases. This was as well perceived by the managers an engaging factor. This aspect of engagement resonates with the nature of the Technologist as a knowledge worker (Drucker, 1999).

None of the managers viewed positively, or implemented, the 20 % free time to work on unrelated projects made famous at Google in the last part of the last decade (it seems that Google is decommissioning this idea as well). Rather, they preferred different approaches to promote emergent innovation: allocating either hunk of time or engineering budget and present engineers with a problem to solve.

While managers were by-and-large interested in having measurable data for the team and individual performance as connected to the product development (e.g. velocity / features per unit time), they did not mention direct measurements of each person's engagement, as

it has been seen implemented by other firms (e.g. at Jet Blue or Sysco) (Davenport, Harris, & Shapiro, 2010). The managers interviewed rather relied on proxies to measure engagement. All managers implemented one on one interviews with their reports (and in some cases with their skip level reports as well) to keep the pulse of the situation. The engineer's behaviour toward his/her peers at meeting was mention often as a proxy for engagement (or disengagement).

Some common trends were identified across the different interviews for levers to promote engagement in software engineers. Engineers' motivation was positively correlated with problem solving, in the sense of putting engineers in the position to solve challenging problems. Note that this is different than providing solutions for the engineers to implement, which was instead identified as detrimental for engagement and innovation. This again resonates with the knowledge worker paradigm (Drucker, 1999) and with Google's and AT&T's finding in terms of performance predictors (Davenport, Harris, & Shapiro, 2010) (Mims, 2015).

Different engineers resonate with different challenges, and managers seemed acutely aware of the different approach that each engineer may use. In general terms, challenges can be either technical or on a product side, with some managers identifying a natural tendency for engineers to migrate from the former to the latter as they increase with experience and seniority.

Engineering managers viewed team composition and shared goals within the team as a catalyst to promote problem solving and growth, with a healthy mix of "adult supervision"

to “young exuberance” identified as a condition to achieve it, confirming some of the literature.

Another way to promote engagement is to provide visibility into the customers’ motivations and needs directly to the engineers. This is also associated with a push to provide as much autonomy as possible in the organization, to allow engineers to move in the voids and/or span their activities across silos. This may mean even putting them in direct contact with the final customer to ensure product development is not informed solely by the sales team’s effort at the beginning of the project, but rather is a continuous activity. In addition, visibility over the impact that one’s solution has on the customer is a substantial motivator.

Organizational clarity, management clarity and alignment between the management’s messaging and the reality of the product were cited as well as engagement factors. In the specific, these were hygiene factors in Hertzberg’s terms. For example, thanks to their position at close contact with the customer and with the code base, engineers tend to be very cognizant to the real status of the product. Misalignment between the management’s messaging and the actual state of the product is unlikely to get unnoticed, and it is very likely to generate cynicism.

In terms of psychological contract, the managers interviewed reported very limited cases of psychological contract breach in their years of experience. This is a proxy to assess (generally) correct management of the engineers’ expectations during the employment relationship. Reasons for this are the massive employment of one on one meetings, mentioned by all managers as a tool they use regularly, and the extensive process that

software engineers and data scientists undertake during the hiring process (e.g. in one case a prospective engineer would interview with eight engineers). The extended hiring process, involving multiple points of contact, was seen as a reason for the lower incidence of psychological contract breaches. This is consistent with the literature's findings, both in terms of the maintenance (Guest & Conway, 2002), and in terms of the importance of the recruitment for the formation of the psychological contract (Robinson & Morrison, 2000).

The tech sector has also been in the news in the last years for the perks that are offered to workers: extremely playful work areas, free food, laundry services, oil changes, etc. The managers interviewed did not see these as motivation factors at all, reporting that only engineers searching for their first role used them as proxies to assess a potential employer. In some cases, an office environment that is designed in a way that demonstrates that management values engineers (adequate equipment, constructive office layout) was viewed as a hygiene factor. Seasoned engineers are less concerned with perks and instead are more interested in the tools that are made available, or in signs that one's activity is actually taken into consideration.

Limitations

While contributing inductively to the existing literature, this study presents some limitations.

In terms of coverage, most of the respondents were based in the Pacific Northwest. While this is one of the primary markets in terms of the US Tech industry and most of the participants possess extensive experience interacting and working with Silicon Valley, a

future study should involve at the very least San Francisco and New York based participants to compare / contrast the primary tech markets in the United States.

The interviewed sample of twelve was appropriate for the scope of the study, and provided sufficient diversity of points of view to develop the analysis. The semi-structured interview allowed for the argument and analysis, but future studies are expected to involve either a structured approach or a deductive approach with questionnaires. A larger data sample, covering different regions either of the United States and possibly of the world tech scene, would have made the results more generalizable.

The sample involved only managers. While they are in a privileged position to observe and discuss the subject at hand, they are not the only part of the overall system. While most of them had had experience in terms as engineers / data scientists, involving the engineers that they manage or their direct reports would provide confirmation of their reasoning. In addition, other players such as recruiters and HR managers are likely to have insights in this phenomenon.

By its own nature the study is driven by the current (late 2016) prevailing business conditions in the United States, with generally low unemployment in general and a very positive market for software engineers. The scope of the study did not allow a longitudinal prospective following the projection of the subject over a prolong amount of time.

Possible future development

This study could have several possible future developments. On one side, the sample coverage could simply be increased, including managing engineers from other areas of the tech industry in the United States or across the World. While the Pacific Northwest is a

prominent area in the technology sector in the United States, to extend and generalize the findings data points in the San Francisco/Silicon Valley and New York area should be included.

In addition, the sample could be expanded to include the other key players in the relationships: the software engineers in the first place. A contrast / comparison between the direct reports and the direct manager, possibly involving data from the team or individual velocity, is expected to confirm or dispute the findings of this research. In this case, a longitudinal prospective in the form of possibly repeating the interview at a time distance is likely to provide a perspective into the development of the relationship between software engineers, employers and engagement / productivity. Involving HR practitioners and recruiters would provide insights from actors that are mostly involved at the outset of the employment relationship.

Another possible path to grow from this research would be to distil the findings into discrete hypotheses for a deductive study. We would expect this to involve a structured questionnaire, as well as a possible longitudinal aspect, to validate focused hypothesis distilled from the findings above.

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Appendix 1 – Questionnaire

Questionnaire used to lead the semi structured interviews with the engineering managers.

Research Questionnaire

Date _____ **Interviewee** _____

Introduction and Disclaimer

Thanks for your time today.

The purpose of this research is to understand engagement and talent retention in the Tech Industry. You have been selected as a professional with in depth knowledge and experience in managing software engineers.

The interview format is semi structured: I will ask some open questions to guide our discussion. Please feel free to expand on the questions.

Your responses will be treated confidentiality; they will not be disclosed to any party other than the University. Names of companies and of people will be omitted or modified, if reported in the paper.

You have the right not to answer to any of the questions, to stop the interview at any time and to request for all notes to be destroyed. I will be recording the audio of this interview. I hope to keep this interview below 45 minutes.

Do you have any question before we start?

Subject General Questions

Can you please briefly introduce the company / team you currently are the most active in?

Can you please outline your position and your responsibilities?

Do you manage engineers?

RQ1 – How do tech firms seek and actively measure engagement from their engineers?

Let's begin with engagement.

How would you define software engineers' engagement?

Does engagement determine how productive and innovative an engineer is? If yes, how?

What are the drivers and actions that affect engineers' engagement?

Do you seek engagement from engineers? If yes, why?

How do you seek engagement from engineers?

OPT How do you measure engagement?

OPT How can contribution to Innovative ideas, or Innovation Related Behaviors in general be measured?

RQ2 – How do engineering managers maintain and manage software engineers' expectations?

Let's switch gear and talk about software expectations in the relationship between software engineers' and the company.

Beside monetary, what do you think are the expectations of software engineers from an employer?

What does it mean for an engineer / developer to be successful here? What are the differences between this schema and that of other startups?

How is that schema made clear to the prospective engineer during the hiring process?

Are other engineers involved in the recruiting effort? Are they briefed / trained on how to present the company? How are they trained in how to respond to standard questions about culture and engineering here?

Have you ever had the case of an engineer, or a resource, complaining about a misalignment between his/her expectations and the reality? What was the source of the expectations? Was the source of expectation internal (recruiting, a colleague, an representative of the firm) or rather external (a competitor, an article about the sector)? Can you elaborate on that?

Have you ever had an engineer missing your expectations in terms of performance or behavior? Were those expectations made clear to him/her? Can you briefly elaborate on that?

How would tools like OKRs, appraisals or similar help in managing expectations? Do you have an alternative tool implemented?

OPT During the hiring process and onboarding, is there a formal / planned socialization process? Can you describe what that entails?

OPT How are the implicit promises, beliefs and assumptions that new engineer may develop considered during hiring and onboarding?

OPT What is the impact of considering and actively managing engineers' expectations on the engineers' output?

Closing remarks

Is there anything you would like to add?

Are you happy with being mentioned by name in the paper?

I may call you back / get in contact with you for follow up, is that ok?

Thanks very much for your time.