

On the competition for highly skilled workers in a scarcity-driven context: a system dynamics approach to talent competition in the digital transformation age

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Abstract

This paper explores the relationship of the competition for scarcely available highly skilled workers in an industry that is poised with transformation. The causal relationship on industry transformation that leads to companies seeking to fund their transformation programs, eventually opening positions to hire highly skilled workers that aren't readily available. This dynamic puts pressure not only on the overall compensation but on the industry performance as a whole given draining of talent because of the high turnover in the companies of the industry, further diluting the efforts of highly skilled workers and increasing management pressure to deliver the expected performance.

Finally, we explore two policies and their consequences: increasing the funds obtained to better compete for highly skilled workers in this scarcity-driven context, and a second policy that aims to jointly fund educational programs among the companies inside an industry to increase the overall availability of workers in the market.

Acknowledgements

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thinking and approach were sowed. This paper has also been reviewed by Mario Cezar and Niraldo Nascimento for providing guideful feedbacks on both the model and the writing of this paper.

Introduction

Driven by continuous advances in digital technology throughout the 20th century, the world has seen an enormous social and economic shift into an information age driven by computers and all the technological advances in this area.

Pushed initially by technological innovations such as the "mainframe era" and the IBM dominance in the 70's and 80's, followed by Wintel's (Microsoft Windows operating system + Intel processors) personal computer revolution in the 90's, the advent of the initial adoption of the internet via world wide web protocols and browsers such as Netscape in the late 90's, to the debut in 2007 smartphone market driven by Apple's iPhone as well as other players such as Amazon (leading both in e-commerce with Amazon.com and cloud computing with Amazon Web Services), Facebook's social media reach (with Instagram, Whatsapp and the blue app) and Google's predominance in search, the whole world has reaped both the benefits and downsides of those advances as we begin to reach a point where nearly all adults in the planet are online.

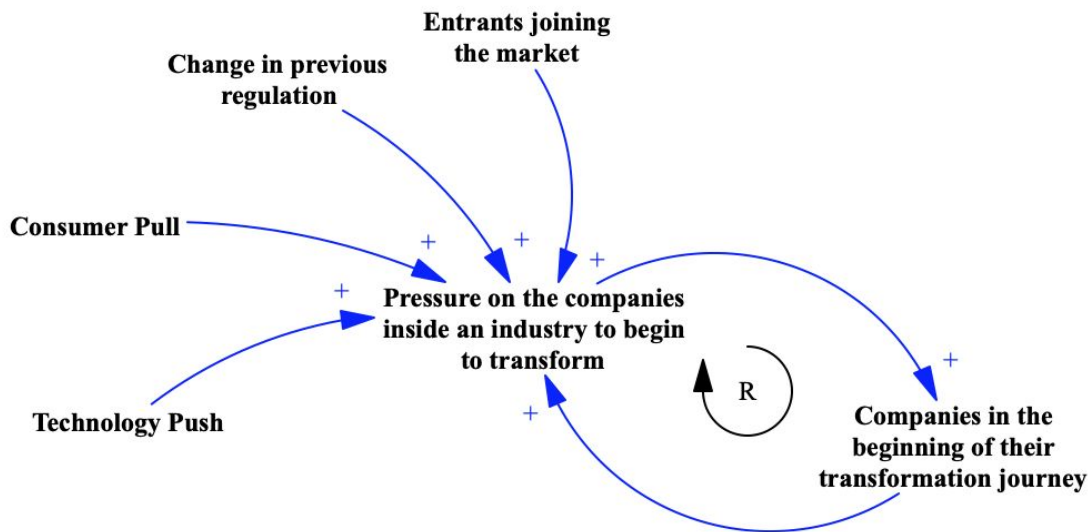
Thus technology push is also driven by a few decades of consumer habit changes expecting high quality products and services centered around their needs, but also more willing to shop online for groceries and other goods, handle all of their financial services using an app, interacting socially via conference services such as Zoom or Whatsapp and even look for their soulmate using AI powered solutions for help them find their best fit.

Both of these forces initiated a pressure in almost all industries (some earlier, others later, few yet to come but surely eventually) to change and transform their business. Pressure to digitize their products and services to meet the demand of their customers but also to defend their position against digital-native entrant companies and find innovative ways to service the market. "Why Software is Eating the World" [1] thesis by Marc Andreessen is a seminal statement on how software will eventually change the way we do business for the next decades to come transforming every industry and companies within it.

This paper builds on previous system dynamics explorations on the topic of workforce competition, workforce turnover and morale. Notably "Attrition of International Seconded Staff in European Civilian Missions" by Manuela Vender and Paulo Gonçalves that explores related dynamics in non-profit international organizations and missions in post-conflict areas [2]

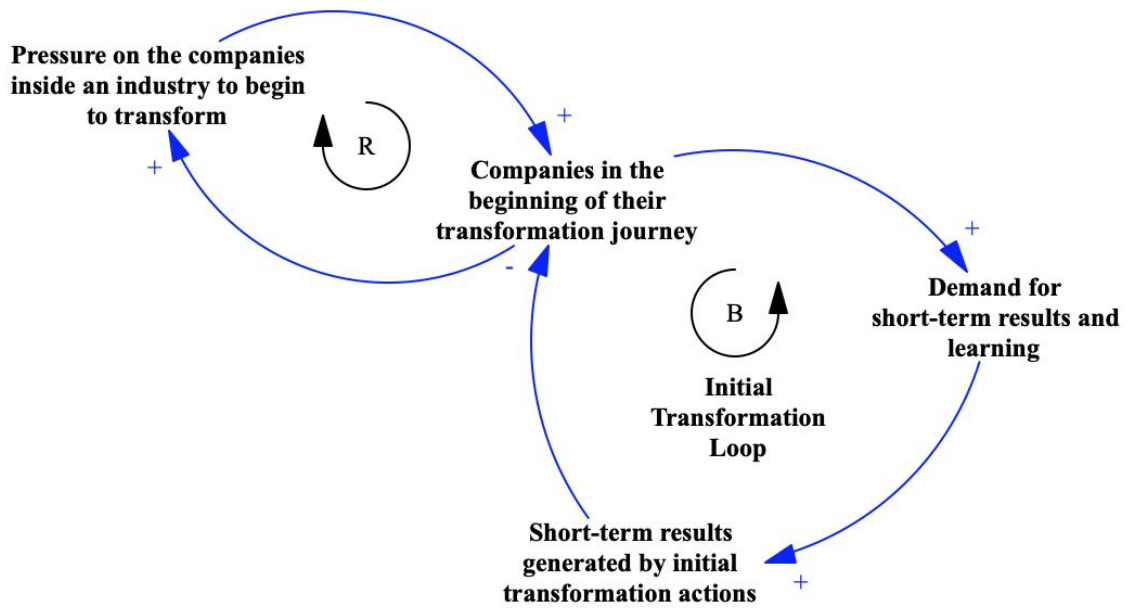
Industry Transformation Dynamics

What we've seen is that given enough pressure from consumers pull, entrants in the market, technology push or regulation, the industry faces a challenge to transform itself, starting from the "early adopters" or sometimes the entrants, eventually putting more pressure on the industry forcing it to adhere to a transformation.

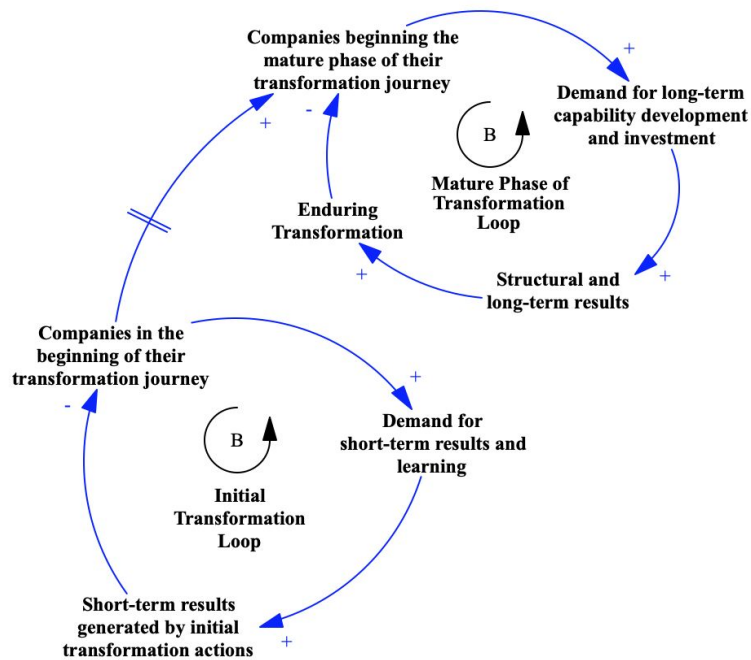


- Consumer pull, technology push, entrants joining the market and changes in an industry regulation all put pressure on the companies inside an industry to begin to transform, which in place lead to more companies beginning their transformation journey, as more companies begin their transformation journey there is additional pressure applied in other companies in the same industry to follow suit. This reinforcing loop eventually push early-adopters into rethinking their strategy and positioning to pursue transformational objectives.

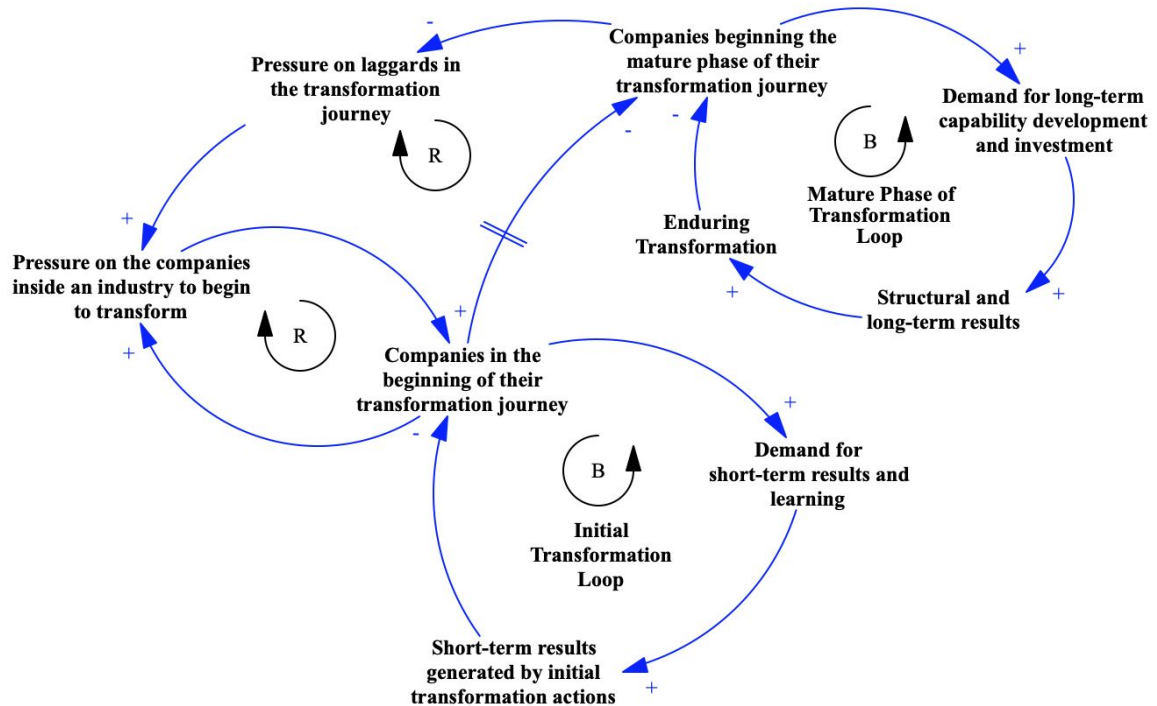
Companies that start their digital transformation journey generate demand for short-term results and learning on the matter, hiring consultancy firms to help them devise their strategy, looking for state of the art academic content from top business universities and also looking and hiring for talents that are suited to the new challenges the company faces. Eventually enough initial transformation actions start yielding short-term results and the company starts to feel more mature and prepared to continue its transformation journey leaving the "novice/apprentice" stage in the industry reaching a more experienced level, thus separating from other companies that haven't reached this state yet.



This balancing loop eventually catapults early adopters companies into a new category within the industry, their needs change and more enduring set of capabilities need to be developed, thus making it possible to generate long-lasting and structural changes in the company, eventually leading to an enduring transformation, and eventually to less companies in the beginning of their maturity reaching a proper mature stage.



Eventually, enough companies start their transformation and go through the "initial transformation loop" leading to more companies beginning the mature phase of their transformation journey which in turn leads to more long-term demand on capability development that generates more structural and long-term results fulfilling an enduring transformation, thus there are now less companies beginning their mature phase but rather more mature companies in the industry. This generates immense pressure on laggards in the transformation journey, leading to more pressure in the companies inside that industry pushing laggards into the transformation journey or death by competition.

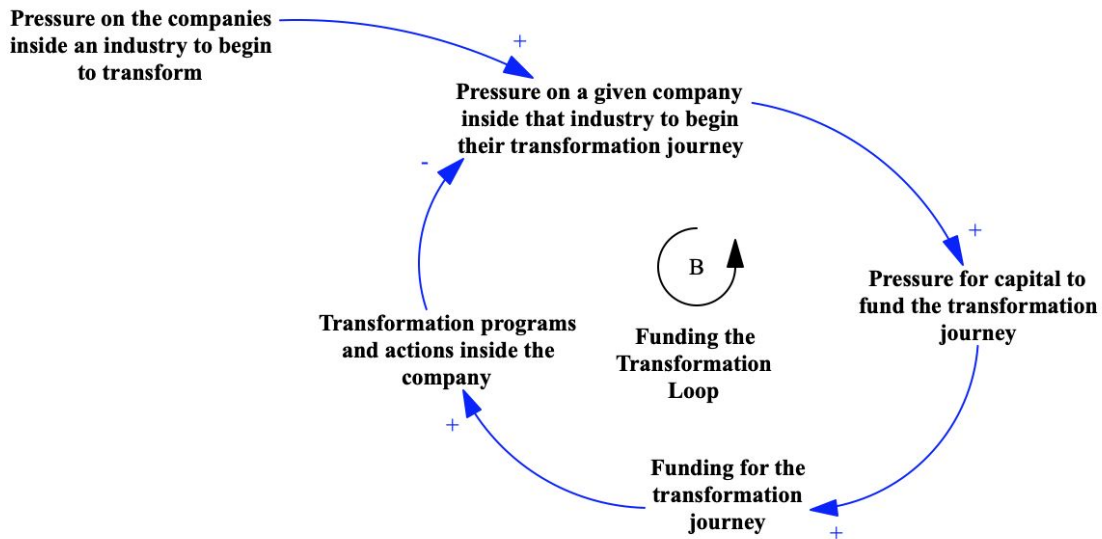


This cycle is the underlying dynamic driving transformation inside an industry. What we aim to study here is the impact of this dynamic in the competition for highly skilled workers and how the cycle explained here introduced immense rivalry between companies that are competing for talents in the software and digital space, eventually draining all available talents given the lack of available talents to fulfill all demand from multiple industries going into that transformation cycle almost at once around the world.

The financial dynamic to fund a transformation effort inside a company

Whenever a strong and enduring transformation cycle begins in an industry independent if your company is one of the early adopters or one of the laggards, eventually most of the (or even the whole industry) industry will pursue similar transformation efforts, thus converging on some of their strategic positions.

What follows is a rush to be able to fund such transformation, either by debt mechanisms in the market or banks, selling assets, defunding other less strategic and priority initiatives or some other means to obtain the needed capital, eventually a strong-willed company will be able to generate enough capital to fund the transformation, or at least the initial years of this journey until some return on the invested capital are able to be obtained.



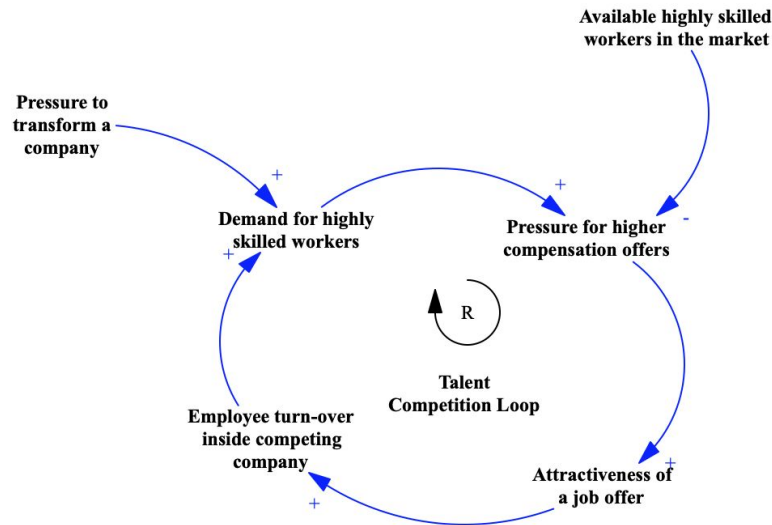
The cycle above explains this dynamic that lies in the heart of the competition for highly skilled workers in a scarcity-driven context, such as the software and digital talents need to execute a transformation while also changing the company's culture. It is important to notice that this is a balancing loop which means that whenever enough capital is obtained, the company stops looking for more funding and begins focusing on the transformation programs and actions inside the company which eventually yields results (if they are successful) loosening the pressure to begin the transformation effort inside that company.

With enough capital at their disposal companies follow many of their initiatives and actions, but as stated above, one of the first barriers to such transformation is the availability of high skilled workers. Being able to attract, develop and retain enough of these types of workers to start and sustain all the transformational initiatives that are much needed is a critical factor to success, and this is the main source of the competition that is being experienced by many companies and industries in almost all countries that have had consumers pull, technology push, regulatory changes or entrants joining the market in the direction for pivot into a transformational journey.

The talent acquisition game

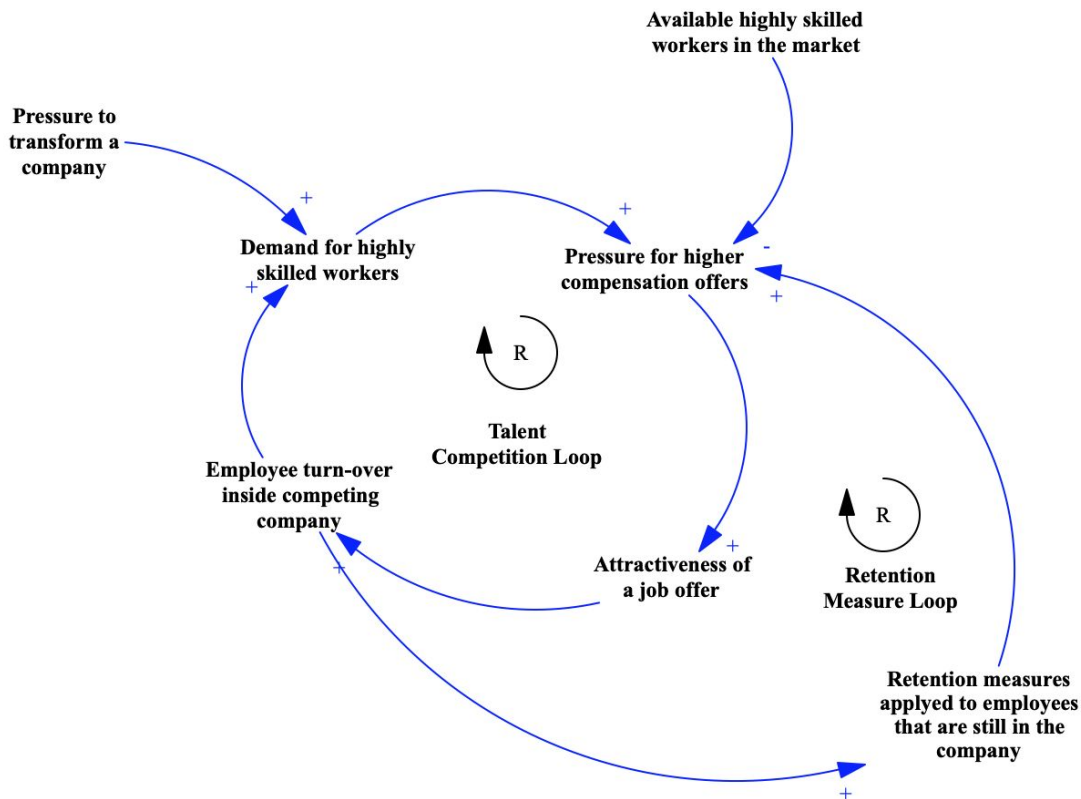
The talent acquisition rivalry depends heavily on the availability (supply) or shortage of talents in the market. Given the recency of most digital transformation cycles in most countries it is safe to assume that in most situations there is more demand for highly skilled workers than available workers in the market. This fact arises from lack of investment in building software development, design or product management skills capabilities into the education system of most countries.

Whenever this happens there is instantly a pressure to be able to offer higher compensation for such talents in order to attract them your company which obviously leads to higher turn-over rates in the company that they are currently working, this attrition however increases the demand for highly skilled workers as now the company that previously had such talent need to fill that spot, and since there isn't enough additional talent available in the market more pressure to increase compensations happens.



Given the funding loop explained above, this competition is capital intensive and puts additional pressure in companies to obtain funds in order to attract and sustain not only the transformation initiatives but the highly skilled talents needed to sustain them.

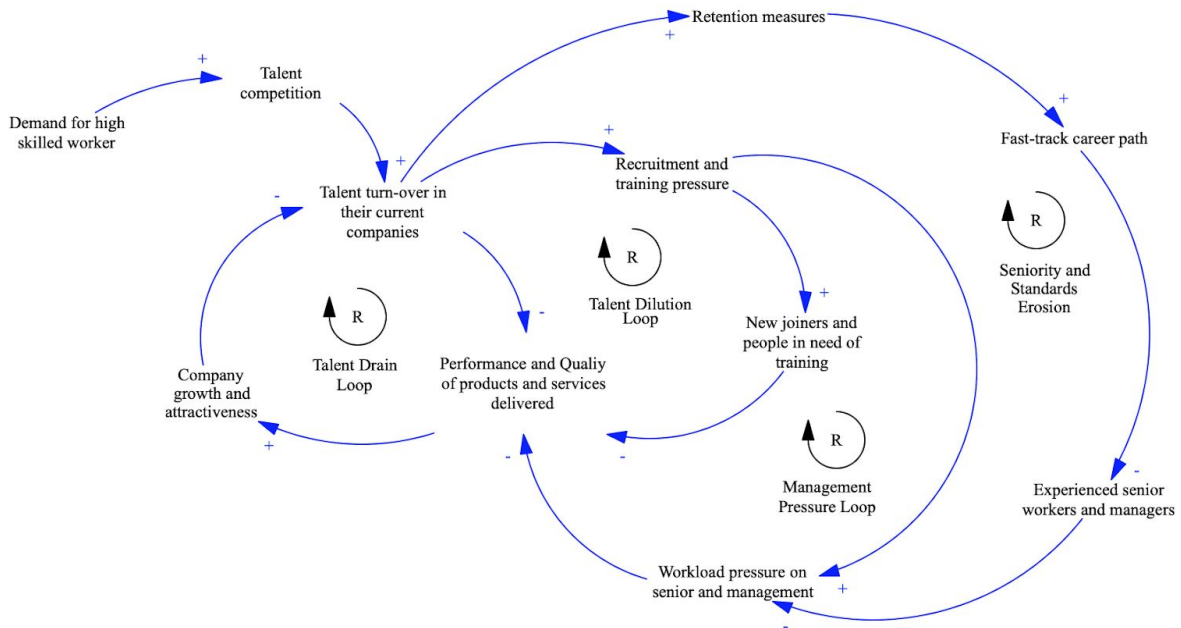
What happens after is an anticipation move from the companies that still have enough highly skilled workers to retain its employees by increasing the overall compensation of those talents inside the company or even developing and speeding up their career path inside the company until they are satisfied and thus proactively retained by their current employer. This move however adds more pressure to the talent competition loop as it makes it harder for companies that need talents but do not have them to attract them. One of the effects that this generates is an additional pressure to increase offered compensation in the market to a point where eventually those highly skilled workers will be inclined to leave their current job and seek another job offer with a higher compensation as illustrated by the causal loop diagram below



These two loops (the talent competition loop and the retention measure loop) generates a dynamic inside the job market that has lots of consequences for the social and economic aspects of that particular industry.

Some consequences of this dynamic appears in the fact that given the scarcity of talents some people become suited (out of necessity from the hiring companies) to senior positions that would take years for them to be able to fill, since a more senior job offers increases the chance of hiring a candidate we experience the phenomenon of people in leadership roles without the proper skills or even the necessary time in order to build enough competence to be able to sustain such position or even to deliver on the expected job description. It is important to note, as an historical aspect, that the same situation happened during the French Revolution and was what helped Napoleon Bonaparte to rise the army ranks in less than 5 years. [3]

However such moves helps to erode a company capability or even render less fruitful all the investment into the building of the capability needed to deliver on the transformational challenges the companies face. This generates impacts on the company culture, employee satisfaction and retention but also in the overall industry quality as experienced by the customer or as it is benchmarked to more sustainable markets in terms of talent availability.

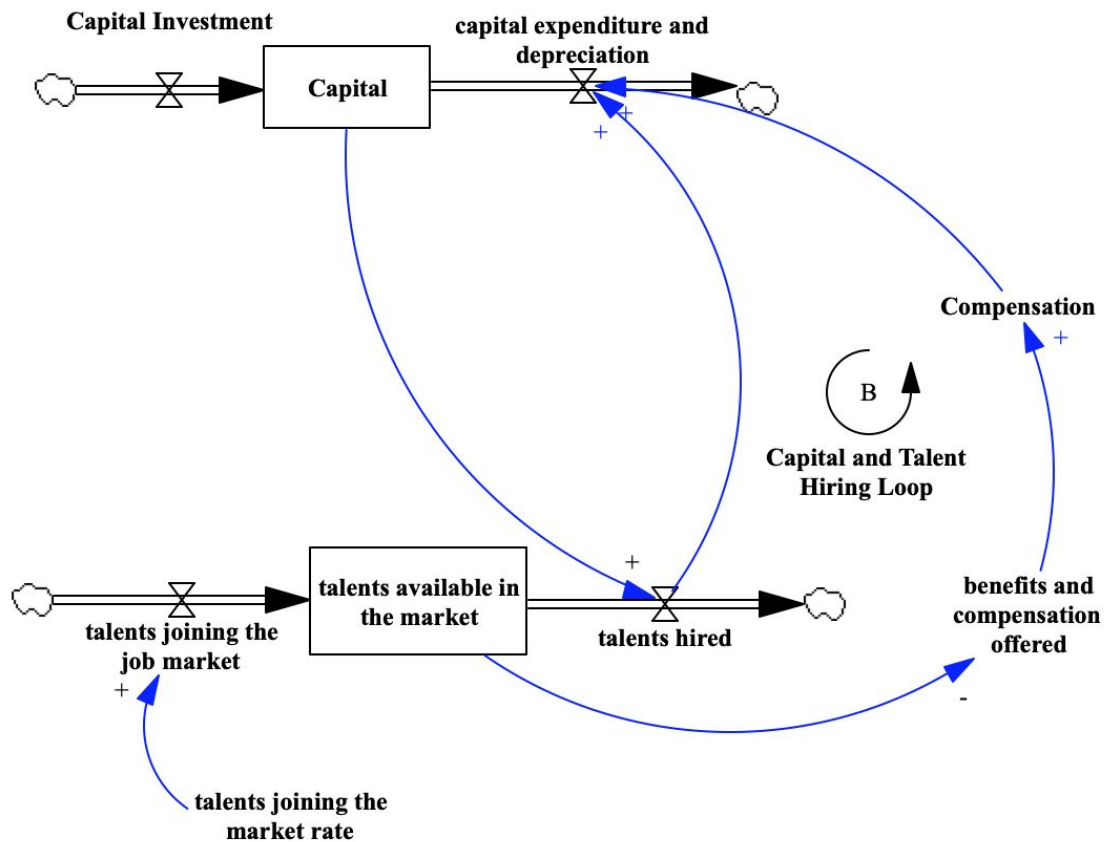


The Talent Drain Loop, in which a company's growth and attractiveness decrease because of talent turn-over given the competition. The Talent Dilution Loop, in which a company increases recruitment and training pressure in order to balance the turn-over generated by the Talent Drain Loop and thus increases the flow of new joiners and people in need of training diluting the impact of senior people, which in turn generates more workload on the senior people and managers decreasing the company's performance and quality standards.

Another consequence of these dynamics is the increased financial pressure on companies trying to compete for these types of highly skilled workers. In other words, in addition to the initial funding there is an (sometimes unanticipated) increase in the company's payroll, more often than not, this creates another dynamic where seasoned staff from other parts of the company see new joiners getting higher compensation and senior positions then they have thus generating lots of problem for employee morale, trust in management and pressure in the leadership and HR department.

Stock and Flow approach to the problem

In a simplified way, the talent competition could be modeled as a *renewable stock archetype constrained by another renewable stock*, much like the fishing economy as postulated by Donella Meadows in Thinking in Systems book [4], as exemplified below:

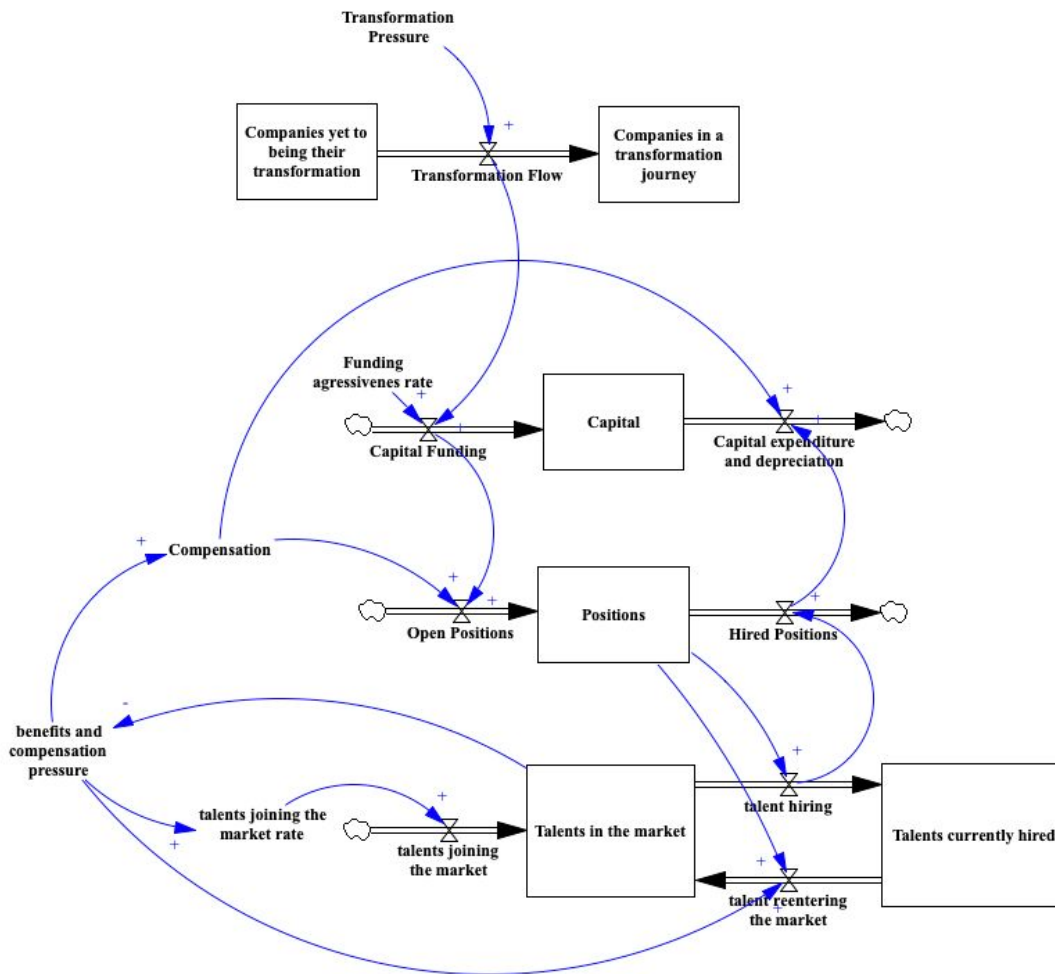


- The higher availability of capital increases the rate of talents hired, which in turn lowers the stock of available talents in the market. This leads to an increase in benefits and compensations offered that consumes at a greater rate the available capital, thus balancing the loop.

Since the talents available in the market is a renewable stock at a given rate, there is a new cohort of talents entering the market from time to time, if the "talent harvesting" is sustainable (meaning: the amount of talents hired is lower than the talents regeneration rate, then the market goes into equilibrium until capital investment in that particular skilled worker is no longer necessary.

However, this model is too simplified to simulate the current situation, since it lacks both the transformation loop that builds pressure on funding and talent hiring, eventually depleting all the available talents in the market, putting immense pressure on the benefits and compensation offered consuming the capital available faster.

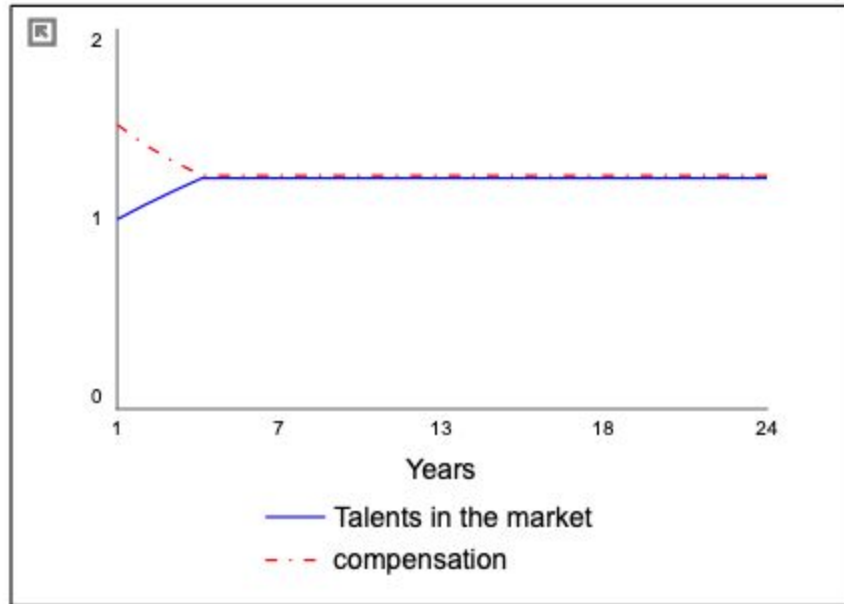
This second model has co-flow structures that better model and simulate the dynamics happening in the market, as shown below:



- This model replicates the industry dynamics of companies transforming themselves, raising capital to fund initiatives and hiring, thus opening positions for highly skilled workers to be harvested in the market. Benefits and compensation is an inverse function of how many talents are available in the market, the more there are the lesser the benefits and compensation pressure, the less there are the bigger the benefits and compensation pressure. Eventually this pressure is so big that even employed talents will rejoin the market to capture the value of higher benefits and compensation offered.

The systemic impact of multiple companies transforming themselves where talents available in the market is scarce

As one would imagine, in a market where there isn't any significant change in the status quo, the average compensation should seek equilibrium with the amount of talents available in the market, such situation should be describe in the graph below

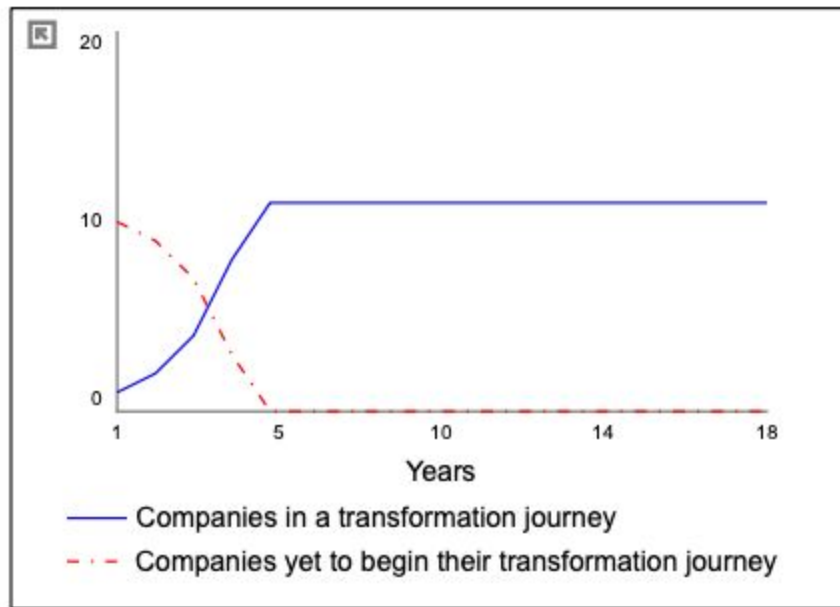


- The compensation raises up to a point where enough talents decide to enter the market, increasing supply thus lowering the compensation offered. This graph illustrates an equilibrium after a couple of years

However, what is happening in the technology space for talented developers, designers, product managers and related skills is exactly the opposite. Considering a hypothetical situation where 10 companies in a given segment decide to enter a transformation journey, and as such they go through all the steps described in previous causal loop diagrams. Simulating a situation where they all fund themselves in a roughly similar amount, and considering an initial compensation paid on average for this type of worker, what we find is a very different scenario.

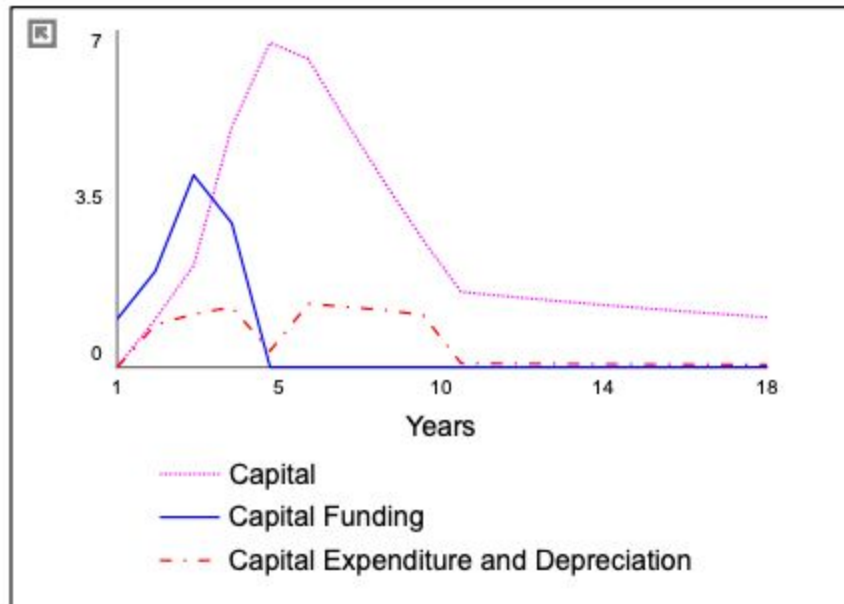
The graph below illustrates a transformation pressure applied in an industry whenever an entrant joins the market or an incumbent makes the first move into a transformational journey, thus resulting in transformation flow of companies inside that industry.

In the example below we have simulated this dynamic in an industry comprised of 10 companies where one company makes the transformation move. Different sizes of industries could be explored here, but for simplicity sake we've narrow this down to 10 companies in this exploration

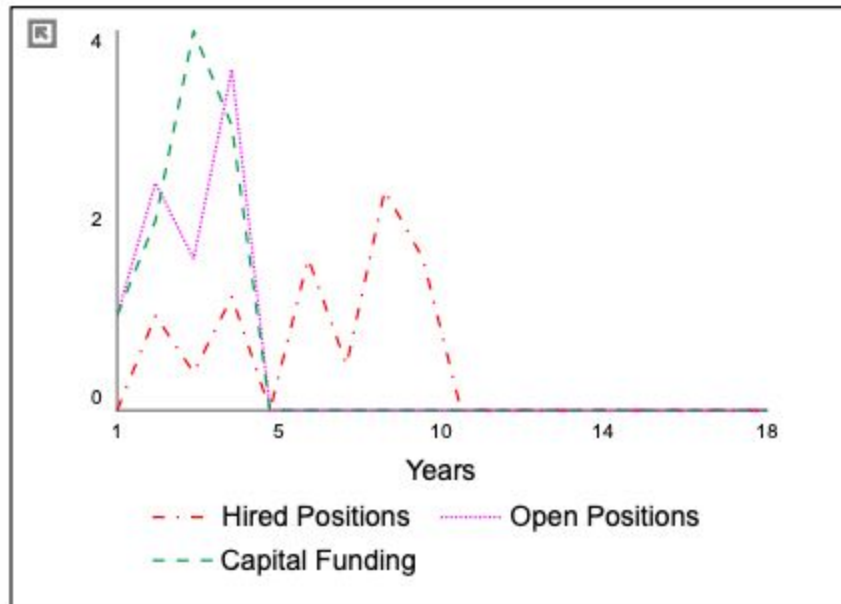


The problem however is that this is increased rate of companies transforming over time forces multiple companies to begin their transformation journey concurrently because their competitors moved into a transformation journey speeding things up, thus creating huge bottlenecks in the system.

Another important factor is the behaviour of capital funding, stock of capital and capital expenditure/depreciation over time. As one would imagine what we see is an increase in the capital available, eventually peaking and then declining. The graph below illustrates this in detail

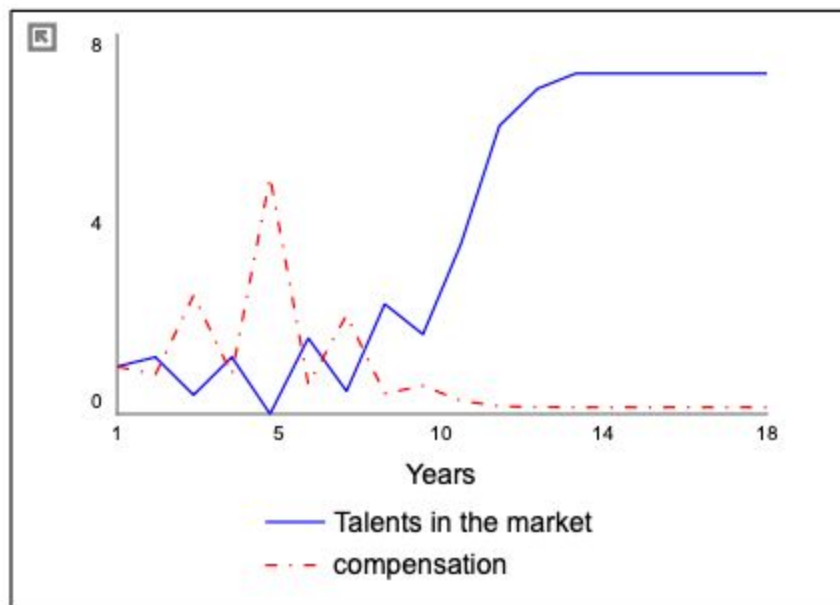


A critical factor is the relationship of capital funding and the amount of open positions/hired positions in these companies. Two behaviours generate deep insight into this situation: first, the obvious relationship of capital funding and open positions in the industry, whenever one grows the other follows. The second, the delay after which the industry has stopped funding itself and the time it takes for hired positions to drop to zero. Another important note is that given that workers needed for this kind of job are a scarce skill that isn't readily available in the market, as long as there is more funding happening, there are always more open positions than hired positions, however, eventually all the companies in the industry fund themselves, inevitably lowering the open positions rate.



This is an important dynamic as those opened positions pull workers from other areas of society into this type of work, eventually raising the amount of talents available in the market and eventually lowering the compensation.

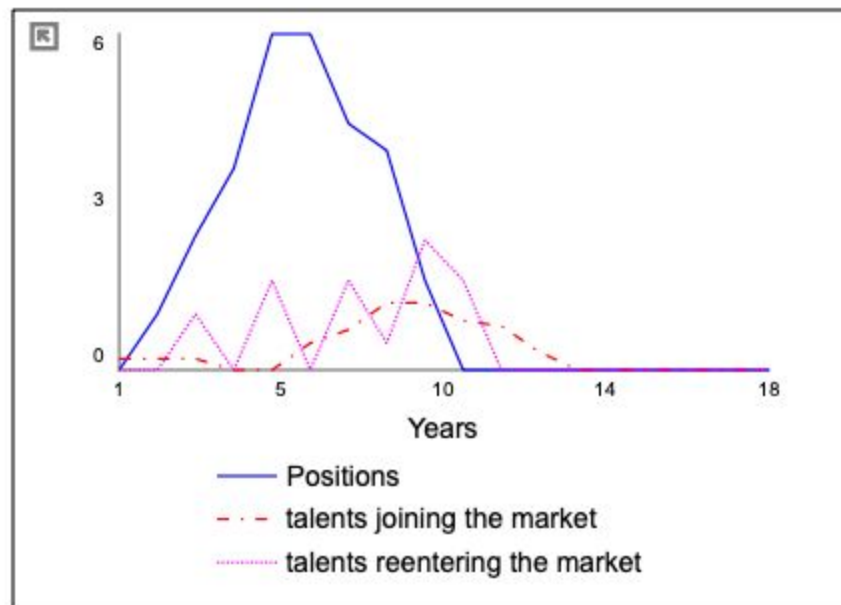
The most crucial aspect experienced in this type of industry is the relationship between the stock of talents in the market and compensation. As one would imagine, this is an inverse relationship, meaning, the more talents available in the market there are, the lower the compensation offered, this is exactly the dynamic shown in our simulation below.



Compensation initially rises because of all the open positions and the scarcity of workers in the market, eventually depleting all workers available in the market, which in turn forces for another increase in compensation to pull more workers (both already working in jobs within the industry or new ones) to join (or rejoin) the available market, whenever this stock reaches a certain amount, eventually the compensation pressure flips because of the availability of new workers.

One would expect this to be a new equilibrium, however what happens is that new companies enter the transformation journey, thus reigniting the cycle, depleting all available workers and thus putting pressure to raise compensation again. This cycle goes on as long as there are new companies entering the transformation journey with enough funding. However, this system eventually reaches a point where there are enough workers drawn into this market that the relationship is no longer about scarcity but rather of abundance of workers in the market, thus alleviating the pressure on compensation.

A very important dynamic observed relates to the initial scarcity of workers in the market. Given the open positions and lack of workers, the benefits and compensation pressure rises to a point where almost everyone available in the market is hired. However, since there isn't enough workers available for all companies in need of highly skilled workers, what happens is that the compensation keeps rising to a point where the workers currently hired and working for a company eventually are tempted to reenter the market to capture the high compensations offered. The graph below illustrates this situation.



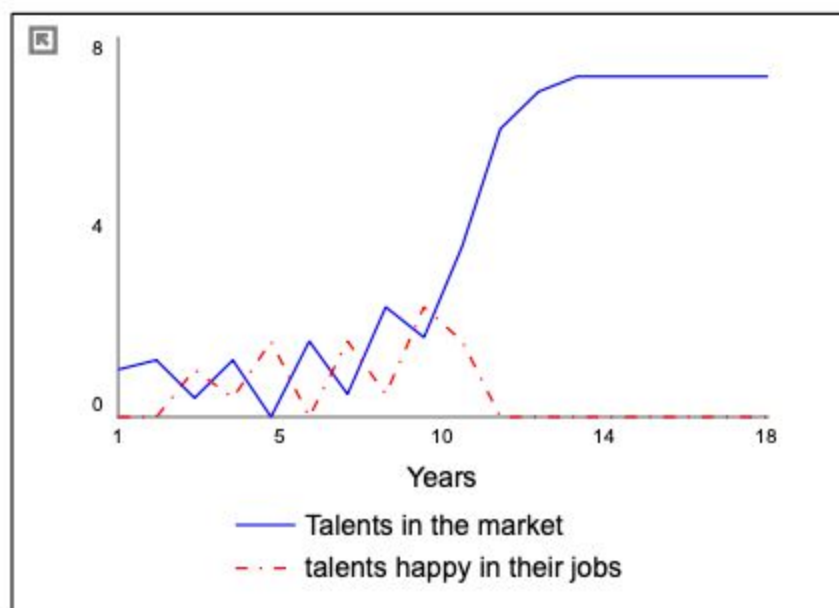
- The stock of open positions is such that talent's joining the market is not sufficient to fill all positions, this in turn puts pressure on the workers that currently have jobs. Since both stocks (talents available in the market and talents happy in their jobs) are not sufficient to fill all demand, what happens is a high turnover environment, where employees show very little loyalty to their employers, flocking from one company to

another in order to capture the ever increasing amount of compensation offered in this industry.

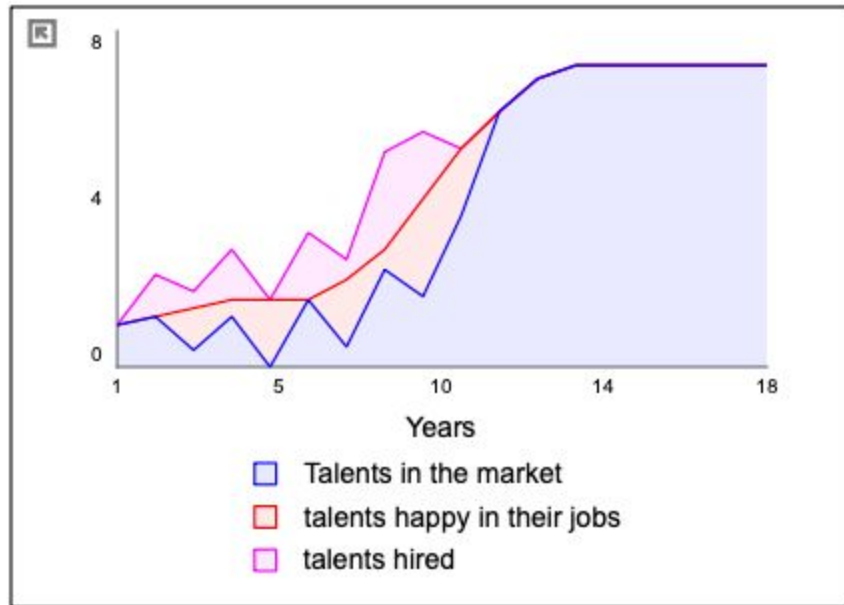
We've explored the consequences of this behaviour in depth in previous causal loop diagrams, illustrated by the talent drain, talent dilution and management pressure that eventually lowers not only a given company performance, but rather the industry performance as a whole.

Eventually there is a temporary advantage of being the "new hot company of the moment" with a bigger and newer funding, thus being able to recruit most the top talents available in the market, but as stated this is a temporary advantage that eventually will be overthrown by a new "sexier company of the moment" that will be able to recruit the best talents in the market in the future.

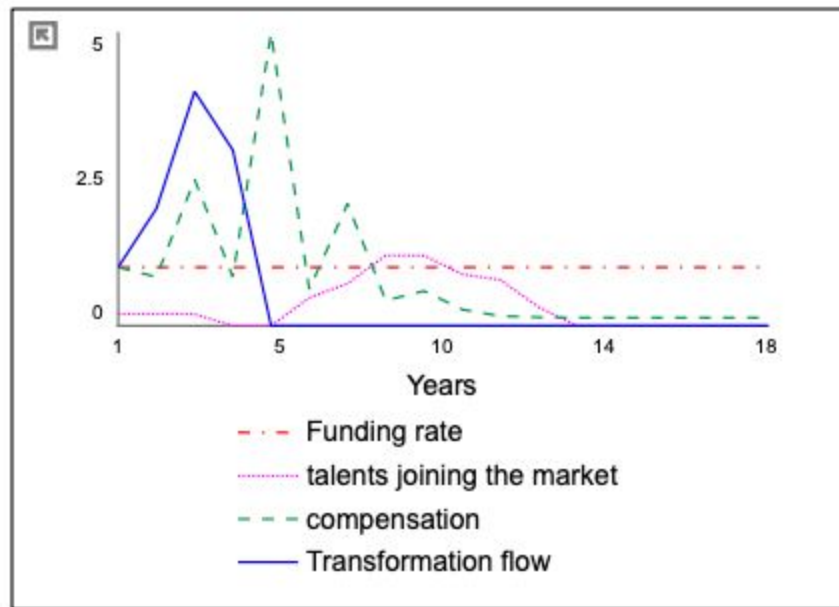
Whenever scarcity is in place, a system behaviour like the one above will happen, as stated, illustrating the relationship of talent's happy and currently working in a company that will eventually decide to leave that company to reenter the market.



In a cumulative view, we can see that as more people join the market because of higher compensation and open positions, the pressure in employees currently with jobs lessen, to a point where the system stabilizes itself, in this case with an increased workforce to satisfy the transformation pull/pressure.



The graph below is the best summary of the complex and systemic relationship of all the important forces shaping the competition for this type of highly skilled workers in a scarcity-driven context: as the transformational pressure increase, more and more companies flow into that direction, first seeking funding and eventually opening positions to hire highly skilled workers, since that aren't enough workers available in the market, a pressure to increase compensation and benefits comes into play, draining funds faster but also stimulating currently hired workers and new workers to join that market because of the temporary opportunity. Eventually, enough workers join the market to meet the demand, thus lowering the compensation and benefits pressure. Most of the time there is an overshoot in this opportunity and more than the demand workers join this market eventually not only helping push compensation further down but rather contributing to an eventual unemployment cycle whenever the transformation demand is supplied.

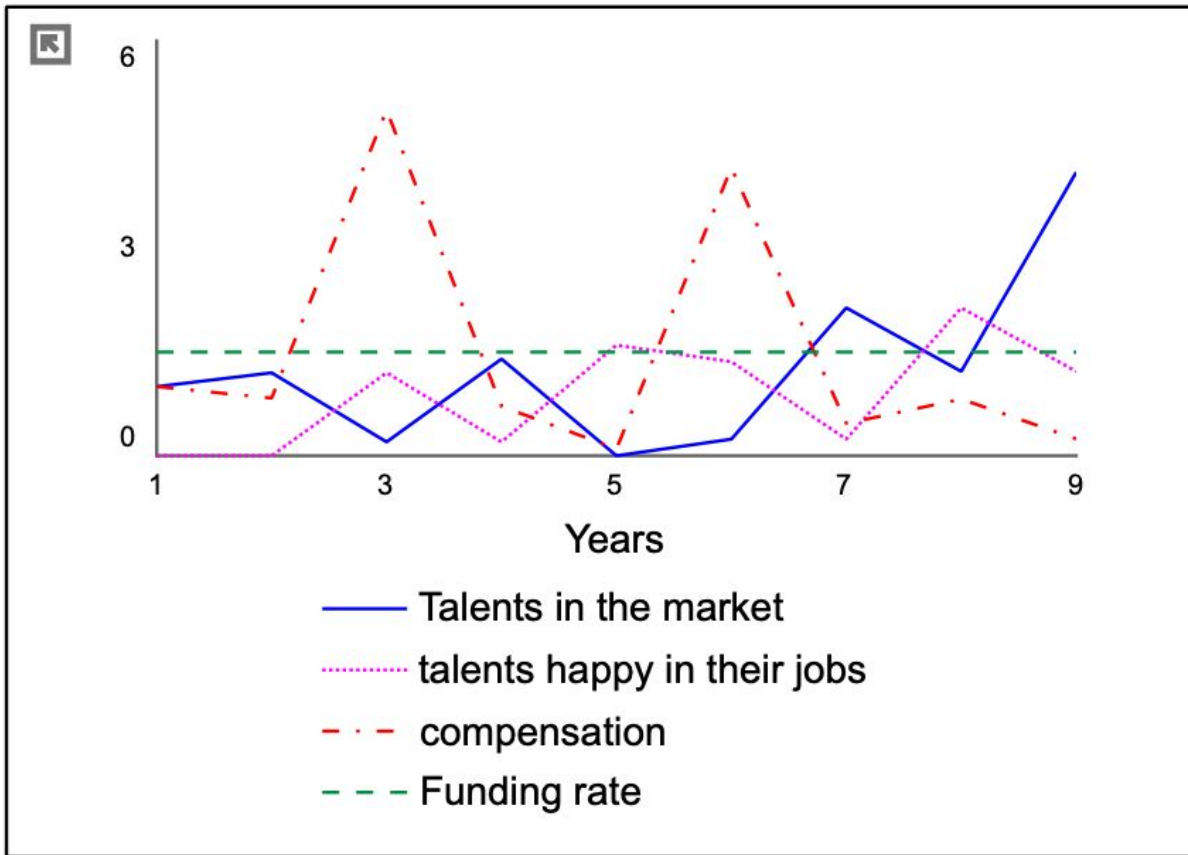


- The graph above illustrates the relationship between transformation flow, funding rate, talents joining the market, and compensation increase/decrease as more/less workers are available in the market.

Possible policies and interventions in the system

Policy 1: Increasing the funding rate that companies get, making them more competitive to fulfill their open positions.

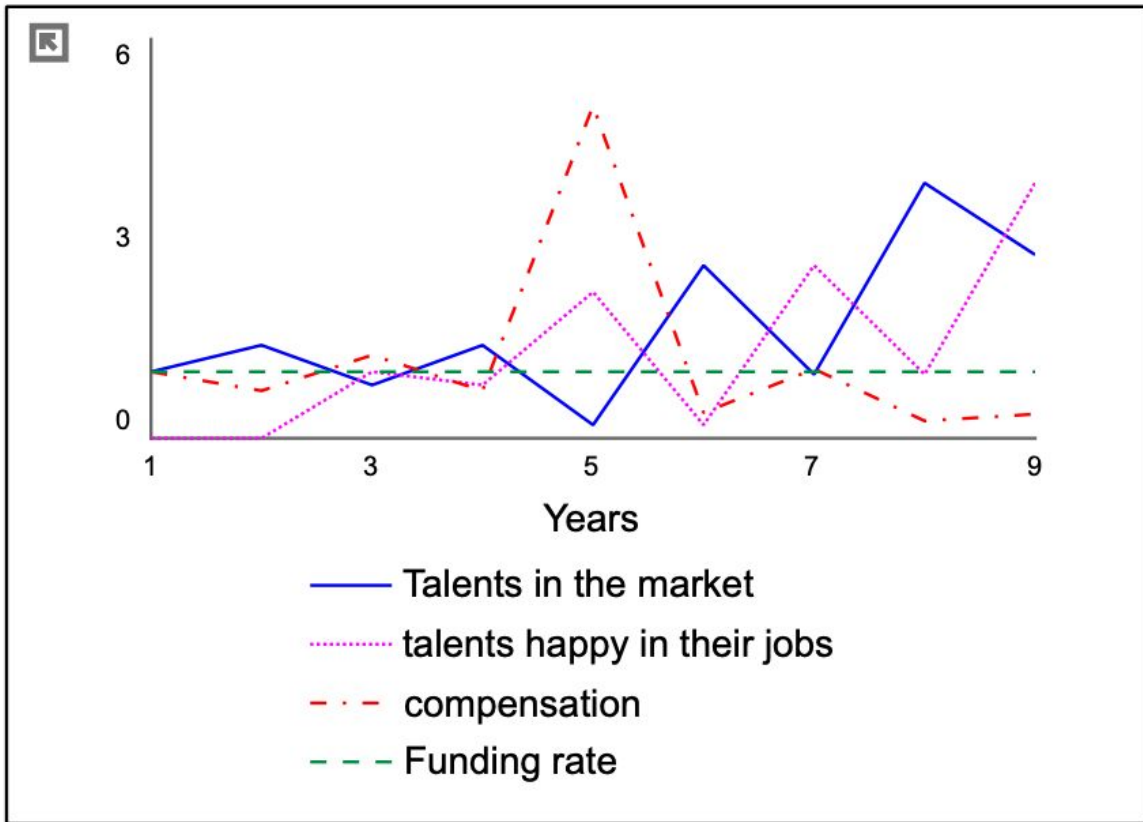
One of the first policies studied in this model is the impact of ever higher funding rates in order to fulfill all open spots faster, forcing the available talents in the market to join their company. We've simulated an increase over time of 150% on the initial funding rate the impact was counter-intuitive in two ways: the compensation offered in the market raises as a direct function of the amount of capital available and offered, meaning that the workers were the ones to benefit most of this policy since the overall compensation rose until enough workers decided to join that market compensating for the additional funding injected. The second important discovery is that the additional workforce drawn into this market also rose, as expected. This could eventually lead to a surplus of workers in the market that could lead to a dangerous unemployment situation in the future.



This policy initially seems to yield good results but any company seeking a sustainable approach to its employees eventually will face worse problems with this policy, as peak compensations are higher, as well as employee turn-over and the market only stabilizes in the future.

Policy 2: Increase the talent's joining the market rate by funding educational programs to teach workers the skills needed for the transformation

Companies in the transformation journey instead of competing against themselves for the scarcely available talents in the market should rather join forces and build educational programs to help train workers in the skills needed for the industry as a whole. Our model showed that an increase in additional workers joining the market from such programs at a constant rate during a sustained period of time, helps decrease the overall compensation and attrition level substantially as shown below. However, while this approach is good for balancing the compensation cycle it leads to the future unemployment problem whenever the demand for this type of worker is no longer needed, increasing the overall talents in the market.



Conclusion

The table below compares both policies considering the variation on funding rate, the additional increase of talents joining the market via a coalition program, the peak compensation of each simulation and the average compensation.

Funding Rate	New talents joining the coalition program	Peak Compensation	Average Compensation
1	None	6.25	4.3
1.2	None	5.21	5.1
1.5	None	5	4.5
1	0.2	5	3.12
1.2	0.2	5	3.33
1.5	0.2	5	3.75

In this article we've explored the complex and dynamic forces operating in the competition for highly skilled workers in a scarcity-driven context. The unintended consequences of over-funding, too many companies flowing into the transformation wagon altogether eventually rises compensation and benefits up to a point where new workers are inclined to join this market. This dynamic most of the time lead to a surplus of available workers which in turn puts pressure to decrease compensation and could lead to unemployment in the future. Another explored dynamic was the relationship of the scarcity that leads to high attrition and turnover in most corporations in the industry, leading to talent drain, talent dilution, management pressure and overall performance decrease in the industry as a whole. We've also simulated policies to intervene in this system and their consequences. One is the increase in the amount of funding most companies get, while this leads to a short-term competitive advantage, other companies in the market respond with even higher funding and retention measures further pressuring the benefits and compensation to rise. Another policy explored was a coalition of the companies in the industry to fund educational programs to train additional workers in the skills needed, what we've found is that if enough workers are trained this will lead to more workers joining the market, putting less pressure on compensation making a better yield of the capital funding the transformation.

While the last approach is the logical one that companies should pursue, this entails a collaborative relationship in the industry that should be lead by competing companies. Such holistic behaviours and understanding of the market dynamics however is rather scarce in the leadership of most companies and industries making this policy less used.

References

[1] - Why Software is Eating the World by Marc Andreessen, published on the Wall Street Journal (<https://www.wsj.com/articles/SB10001424053111903480904576512250915629460>)

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[3] - Napoleon: A Life by Andrew Roberts - 2015. Chapter 2 (Revolution) page 52

[4] - Thinking in System, a Primer by Donella Meadows (<https://www.amazon.com.br/Thinking-Systems-Primer-Donella-Meadows/dp/1603580557>) - 2008