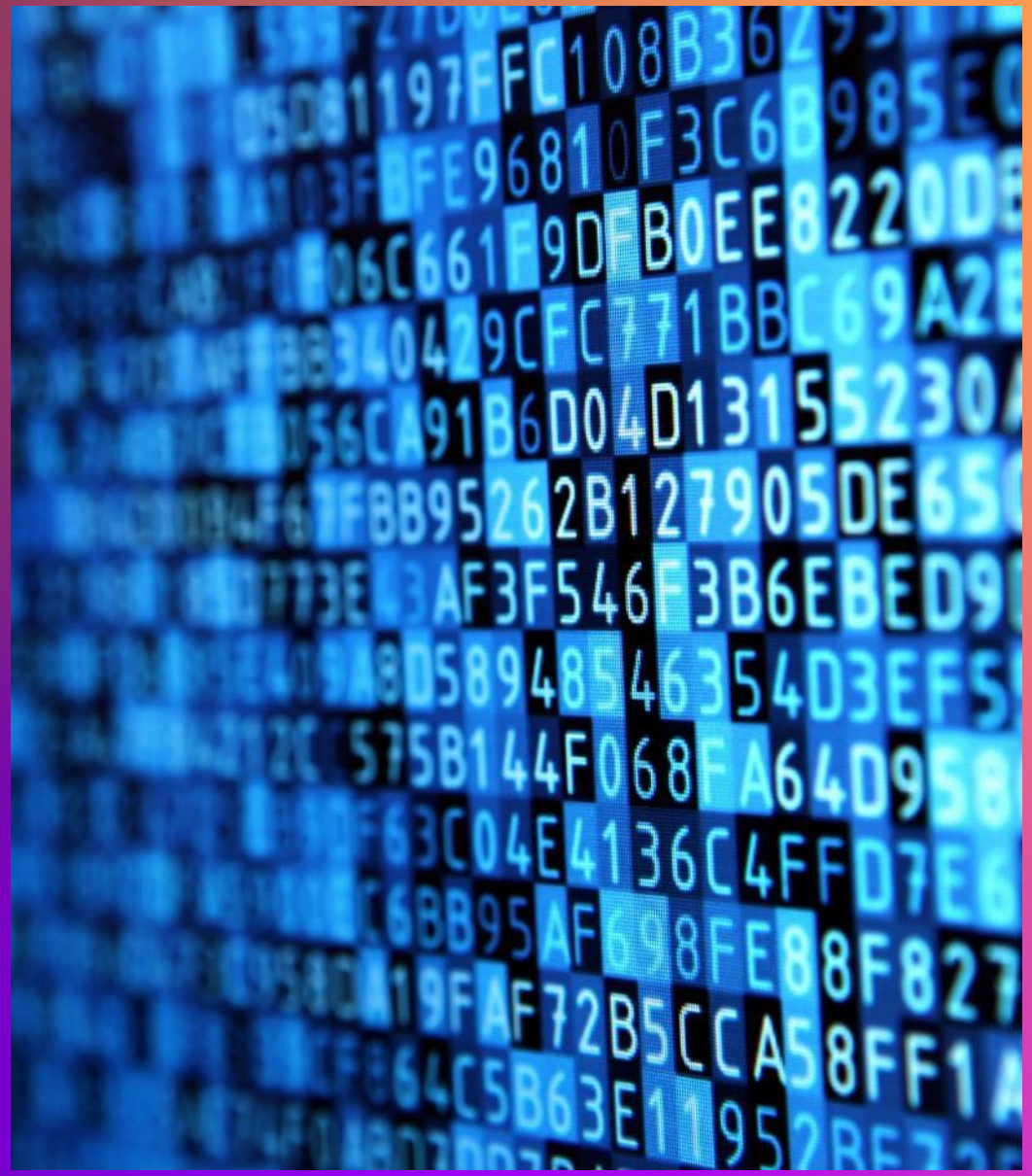
Software Robots & their Impact on Productivity and High-Skilled Workers: A Ground Level View



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Context and Research Contribution

Context

- How automation technologies affect workers and firms: jobs, tasks, productivity, pay, etc.
- Theoretically uncertain: Replacing or Augmenting? Or both?
- Empirical limitations: Heterogeneous technologies, aggregation, conflation, uncontrollable research settings

Research contribution

- Focus on a Robotic Process Automation (RPA) at the workplace level where employees solve client requests ("tickets") & underlying worker tasks per team are impacted by RPA
- Solution productivity & worker outcomes tracked pre-and post-RPA introduction
- Addresses new questions and sheds light on mechanisms

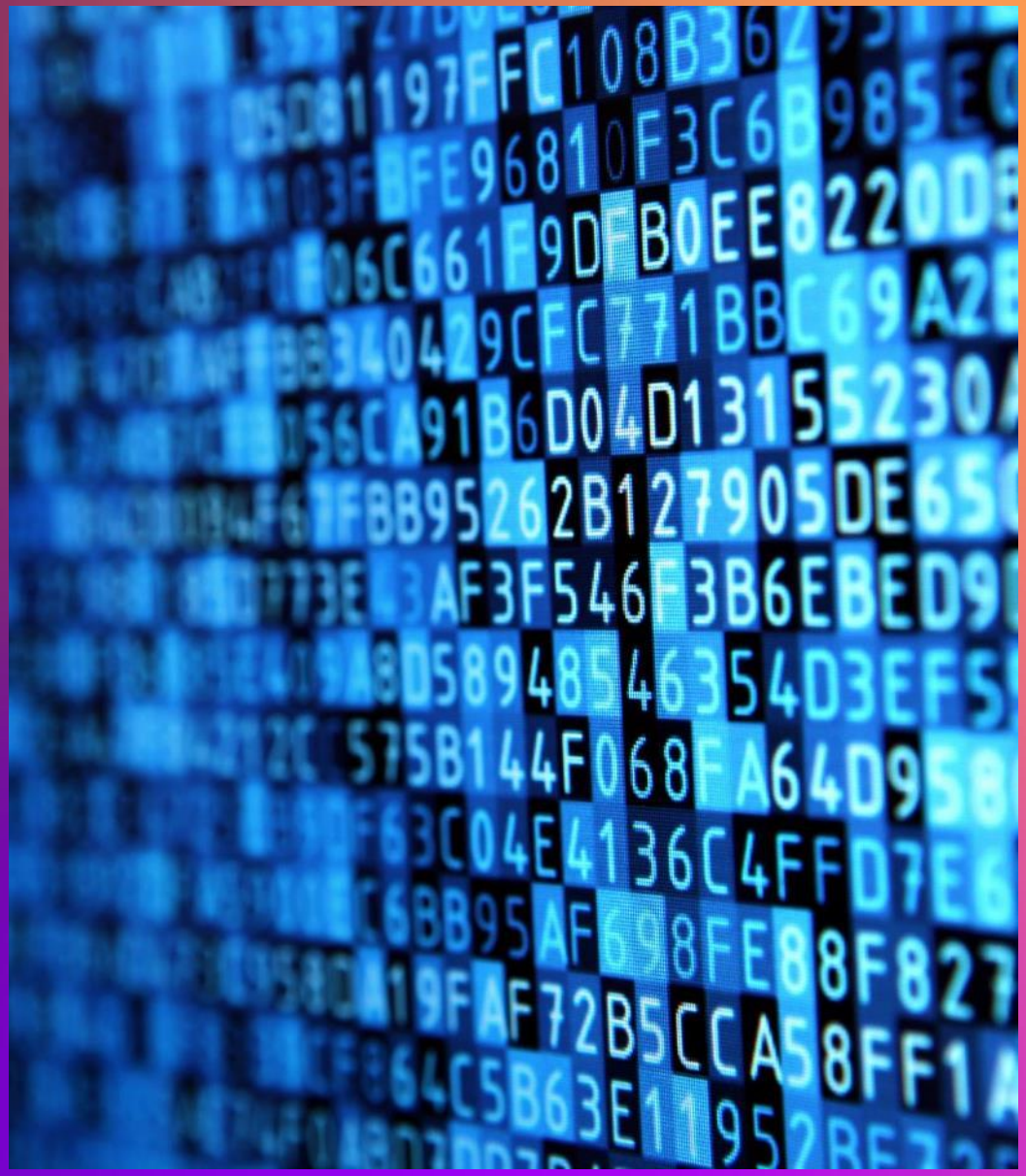
What is RPA?

Technology that automates business processes. Companies can configure a rule-based software, or a "robot," to automate routine steps followed to process transactions, manipulate data, trigger responses, communicate with other digital systems, etc.

Three key insights

1. RPA increases productivity – Average ticket solution times and solution errors fall significantly
2. Processing RPA seems to complement human managerial skills and its impact is higher when applied to more time consuming, yet mundane tasks - average solution times fall more in teams with a higher proportion of managers and for tickets with higher initial solution time
3. RPA "selects in" high performer employees but is unrelated to departures – No direct link to attrition. Also, employees who continued on the project were typically those who earned higher performance ratings prior to the introduction of RPA. Also, after its introduction, these employees secured larger variable and base pay.

Research design



How does Robotic Process Automation impact productivity, work and workers?

OUR STUDY

In March 2017 RPA was introduced into the workflow of around 500 employees providing IT support for a large company. This support involved over 30k requests ("tickets") per month.

The data facilitates tracking of worker career paths and labor productivity over the following year.

Workers were exposed to different forms and intensities of RPA intervention depending on their specific roles – the before and after variation is used to explore the links between automation, productivity and employee characteristics and outcomes.

We combine novel data on tasks ('tickets'), solution times, worker characteristics and outcomes which are tracked before and after the RPA roll-out

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RPA Intervention Setting

- 500 anonymized employees (associates to senior managers in 11 teams) who provide IT support to a large client – tracked between Jan 2016- Aug 2018
- Workers respond to and solve client requests (approx. 30k/month, 900k total)

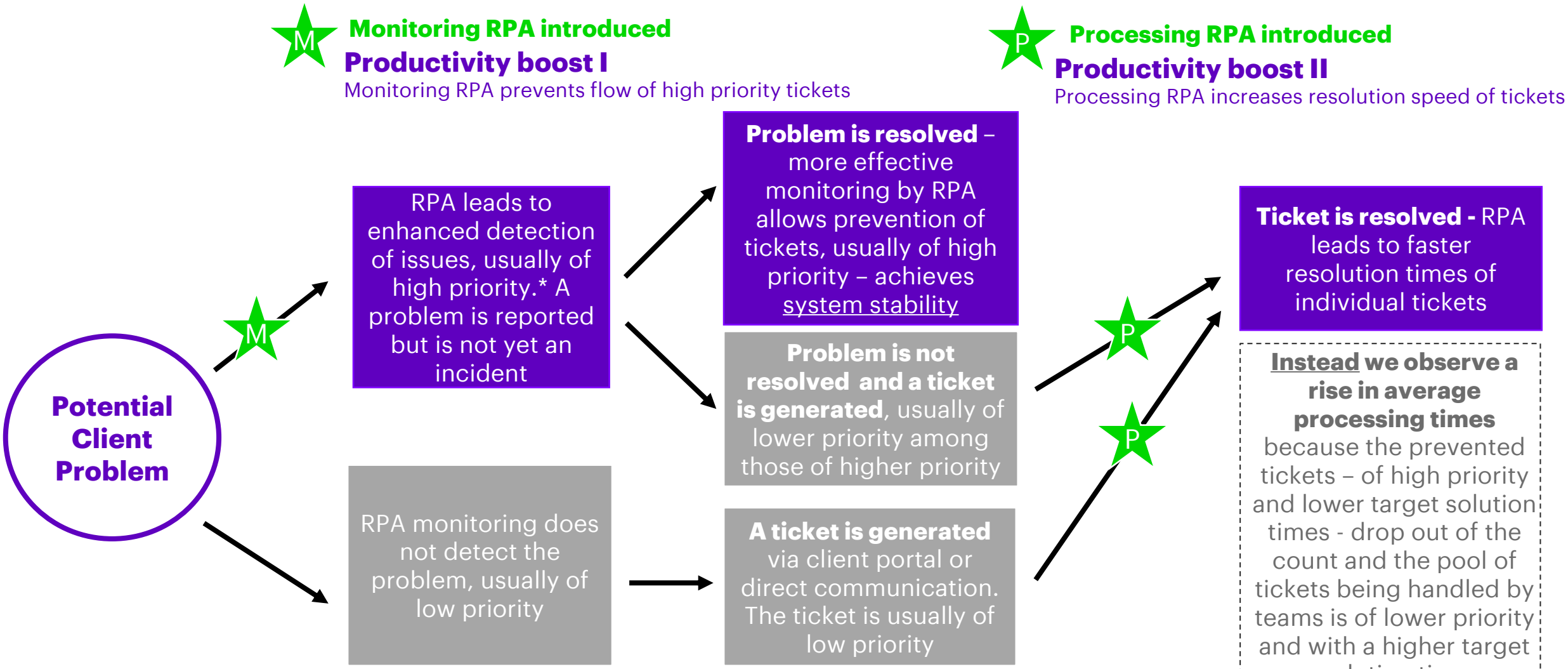
RPA Intervention Tasks/Team Data

- Detailed information on tickets, how RPA affects them & timing of the RPA roll-out
- Measures of productivity (ticket solution time) before & after RPA introduction

HR Worker Background Data Matched to RPA Intervention Data

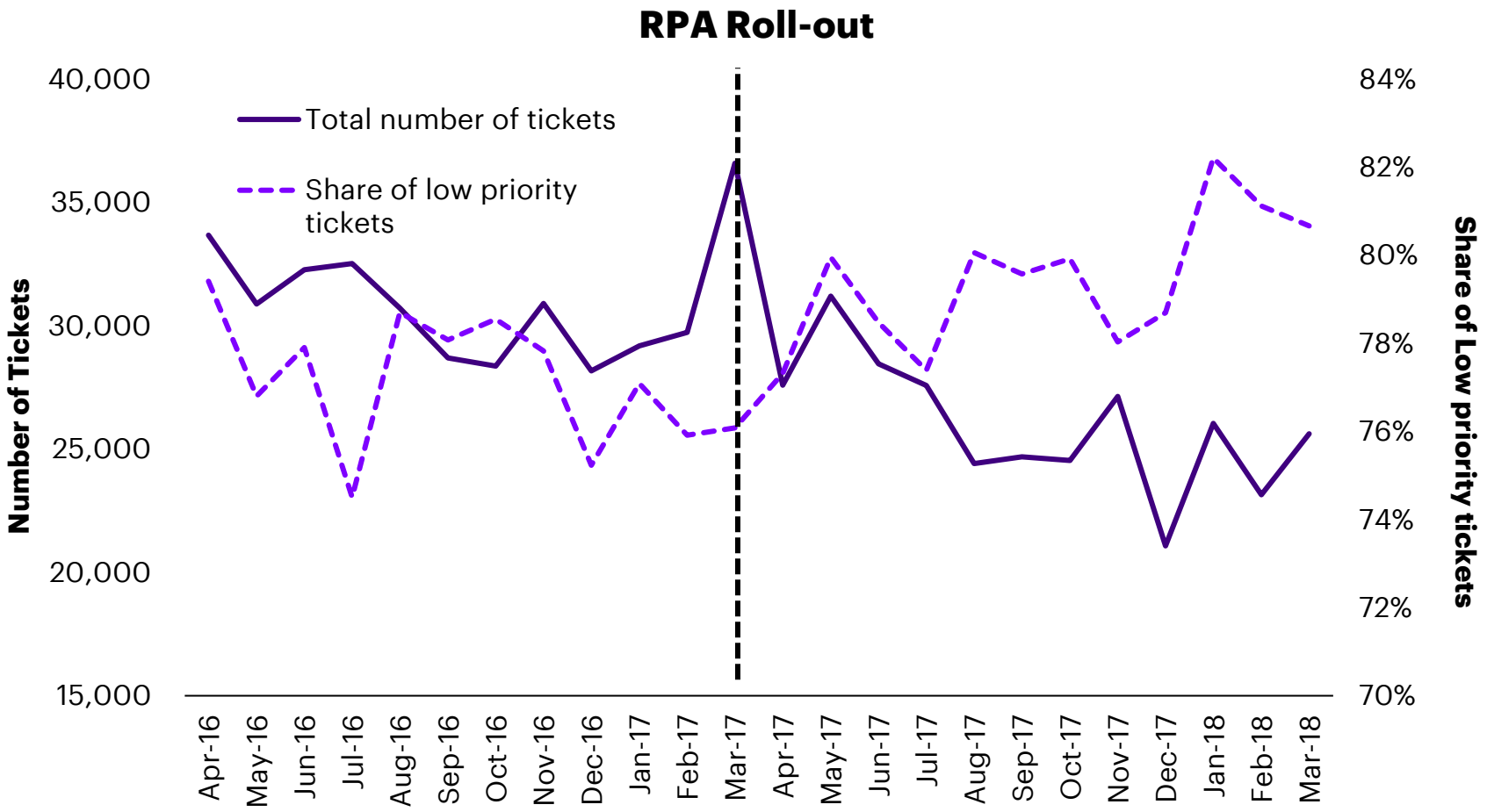
- Demographics (age, gender, education)
- Job history/skills (hire date, exit date (business unit/company), career level, performance rating, promotion)
- Pay/time allocation (compensation, hours worked by category – i.e., chargeable, training and development, etc.)

RPA affects the incident resolution workflow in two important ways



* Note: A ticket is classified as high priority when considered urgent and carries a potentially widespread impact on the business process supported. Once a ticket is tagged as 'high priority' it will have a lower solution time as target. The opposite happens for low priority tickets.

The number of incidents decreases as the composition shifts towards low priority ones



A ticket is classified as 'low priority' when it is considered not urgent and carries a potentially limited impact on the business process supported. Once a ticket is tagged as 'low priority' it will have a higher solution time as target. The opposite happens for high priority tickets.

So must control for both shifts in number and composition:

A ticket type holds constant the following characteristics throughout the analysis period: It is an incident of the same type and priority, originated in the same client's functional area, reported through the same channel and assigned to the same team.

Descriptive statistics by team

RPA Exposure

Monitoring Stage:

Δ share of high priority tickets handled by team

Processing stage :

# of ticket resolution tasks automated on each team/# of workers on team

RPA Outcomes

Productivity:

Solution time in seconds

Percentage of reopened tickets

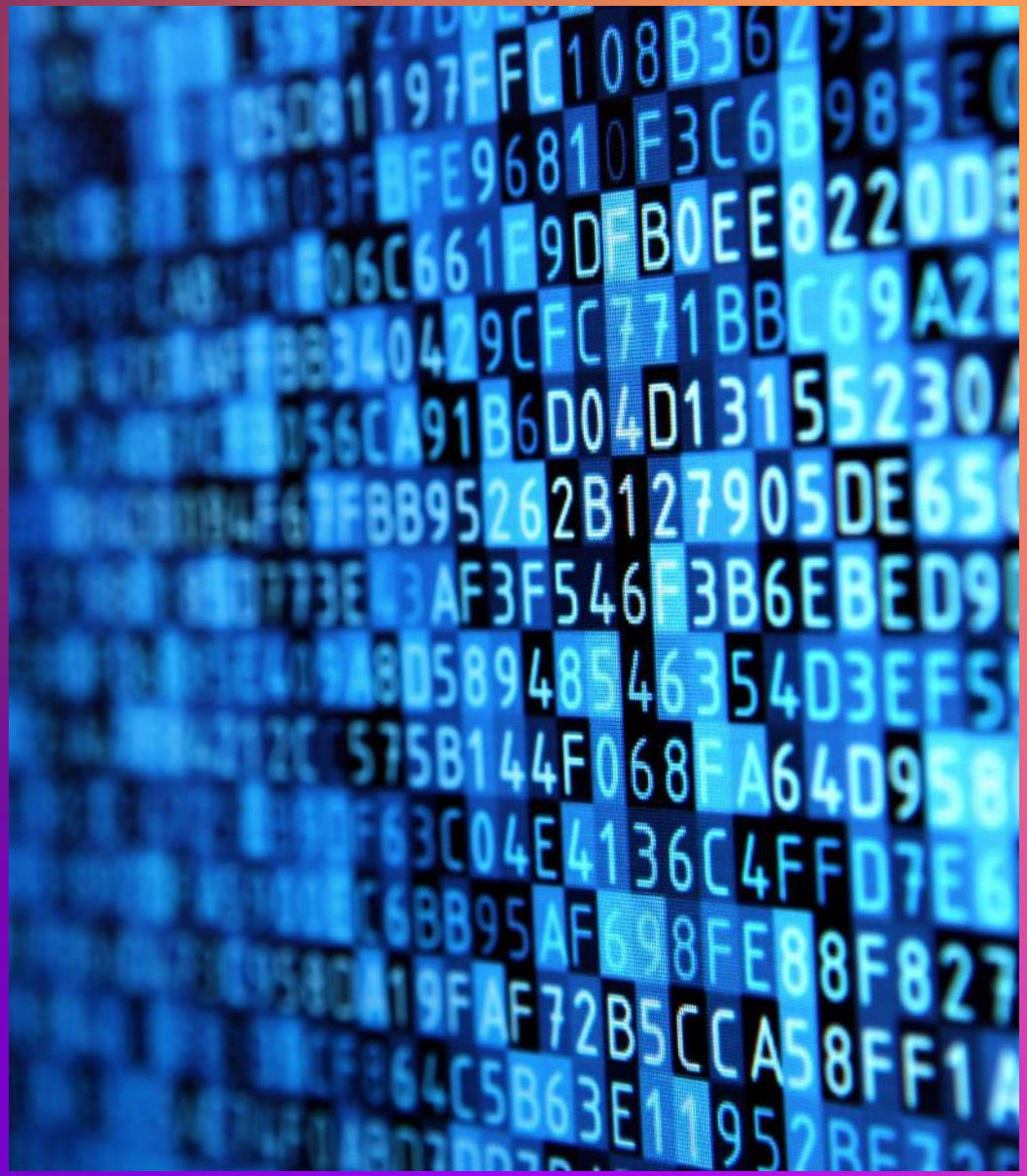
Career path:

Continuity on project, variable and base pay.

Productivity | Processing | Monitoring

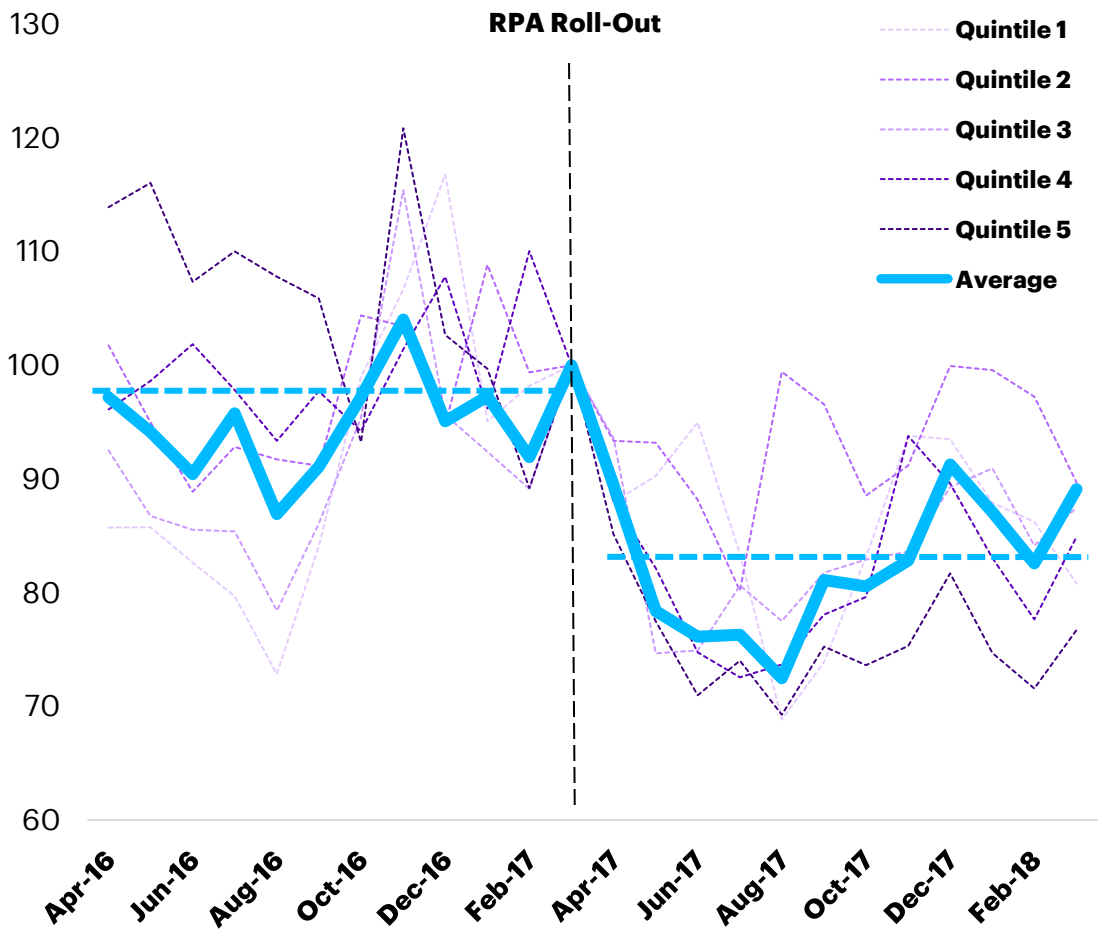
	Size	Managers	Age	Tenure	High priority tickets	Solution time	Reopened tickets	Process RPA	Monitor RPA	Change in # of tickets
	# of employees	*%*	*average*	*average*	*% of total*	*average, secs*	*% of total*	*tasks per worker*	*Change in priority, ppts*	*%*
Team 1	32	9.38	26	2.40	14.24	166,934	3.62	1.28	0.009	-26.98
Team 2	132	17.42	29.5	2.81	32.68	116,568	1.29	0.45	-0.020	-25.70
Team 3	22	4.55	25.5	1.94	39.61	106,916	1.99	1.73	-0.095	-9.78
Team 4	9	0.00	23	1.70	0.92	126,228	0.80	1.78	0.005	-22.90
Team 5	38	13.16	27	2.28	34.55	121,183	1.20	1.03	-0.049	-40.95
Team 6	28	0.00	25.5	1.89	12.68	77,982	1.67	2.32	-0.044	-15.99
Team 7	55	7.27	25	1.84	14.18	99,601	1.18	1.05	-0.039	0.74
Team 8	31	6.45	28	2.01	18.79	99,301	0.06	1.74	-0.036	-34.93
Team 9	28	0.00	25.5	1.62	01.06	147,216	2.18	1.79	0.010	2.10
Team 10	81	2.47	26	2.28	35.16	112,987	1.52	1.27	-0.001	-31.96
Team 11	44	6.81	26.5	2.42	34.12	117,680	2.45	1.23	-0.063	-11.47

Productivity

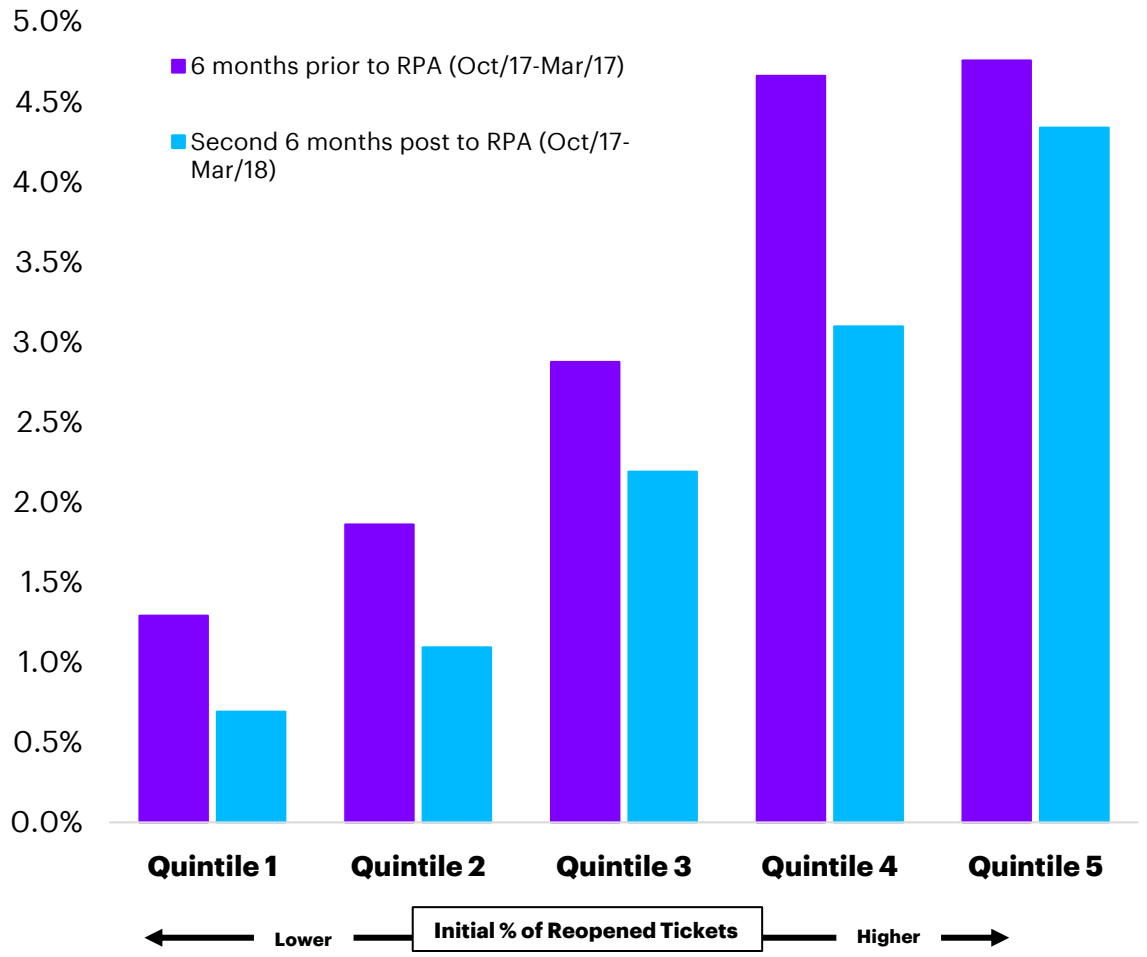


Average solution times and errors fall after RPA roll-out

Solution Times - Index March 2017=100



Reopened Tickets - percentage of total processed



Note: Solution times and percentage of reopened tickets are averages by ticket type. A ticket type holds the following characteristics constant throughout the analysis period: it is an incident of the same type and priority, originated in the same client's functional area, reported through the same channel and assigned to the same team. Quintiles are defined as prior to RPA solution times.

Productivity (and errors*) model

i: ticket types, j: team, t: time period

$$ln(SOLTIME_{ijt}) = c_i + \beta_1 PRPA_{jt} + \beta_2 MRPA_{jt} + \beta_3 \Delta QTICKETS_{jt} + \beta_4 SMAN_j + \beta_5 ln(SOLTIMEini_{ij}) + \beta_s X_j^s + \varepsilon_{ijt}$$

$ln(SOLTIME_{ijt})$	log of solution time of a ticket of type i, handled by team j in period t (4 periods)
$PRPA_{jt}$	Process RPA exposure measure: # ticket processing steps automated per worker in team j in period t,
$MRPA_{jt}$	Monitoring RPA measure: % change in high priority tickets handled by team j in period t
$\Delta QTICKETS_{jt}$	Change in the number of tickets handled by team j in period t
$SMAN_j$	Share of manager and above level in team j before the RPA implementation,
$ln(SOLTIMEini_{ij})$	Average solution time by team j of a ticket type i before the RPA introduction
X_j^s	Pre-RPA team characteristics (average employee age, tenure, size)

* Errors model swaps solution time variable for % of reopened tickets

RPA channels linked with lower solution times

	Log Solution Time	Solution Time Change (%)	(1) Δ Solution Time Change (ppts)	(2) Δ Solution Time Change (ppts)
PRPA	**-0.0904*** **	**-0.0710*** **	**-0.5628*** **	1.6605
MRPA	**-0.3731***	-0.2551	**-1.3774*** **	-0.6628
ΔQTICKETS	0.0483	0.1212	0.0281	0.0140
SMAN	*No*	*No*	*No*	No
ln(SOLTIMEini)	*No*	*No*	*No*	No
PRPAxSMAN	*No*	*No*	*No*	**-6.5191*** **
PRPAxln(SOLTIMEini)	*No*	*No*	*No*	**-0.1761***
Tenure	*No*	*No*	*No*	*No*
Age	*No*	*No*	*No*	*No*
Team Size	*No*	*No*	*No*	*No*
# Obs	1,336	1002	668	668
FE by ticket	Yes	Yes	Yes	Yes

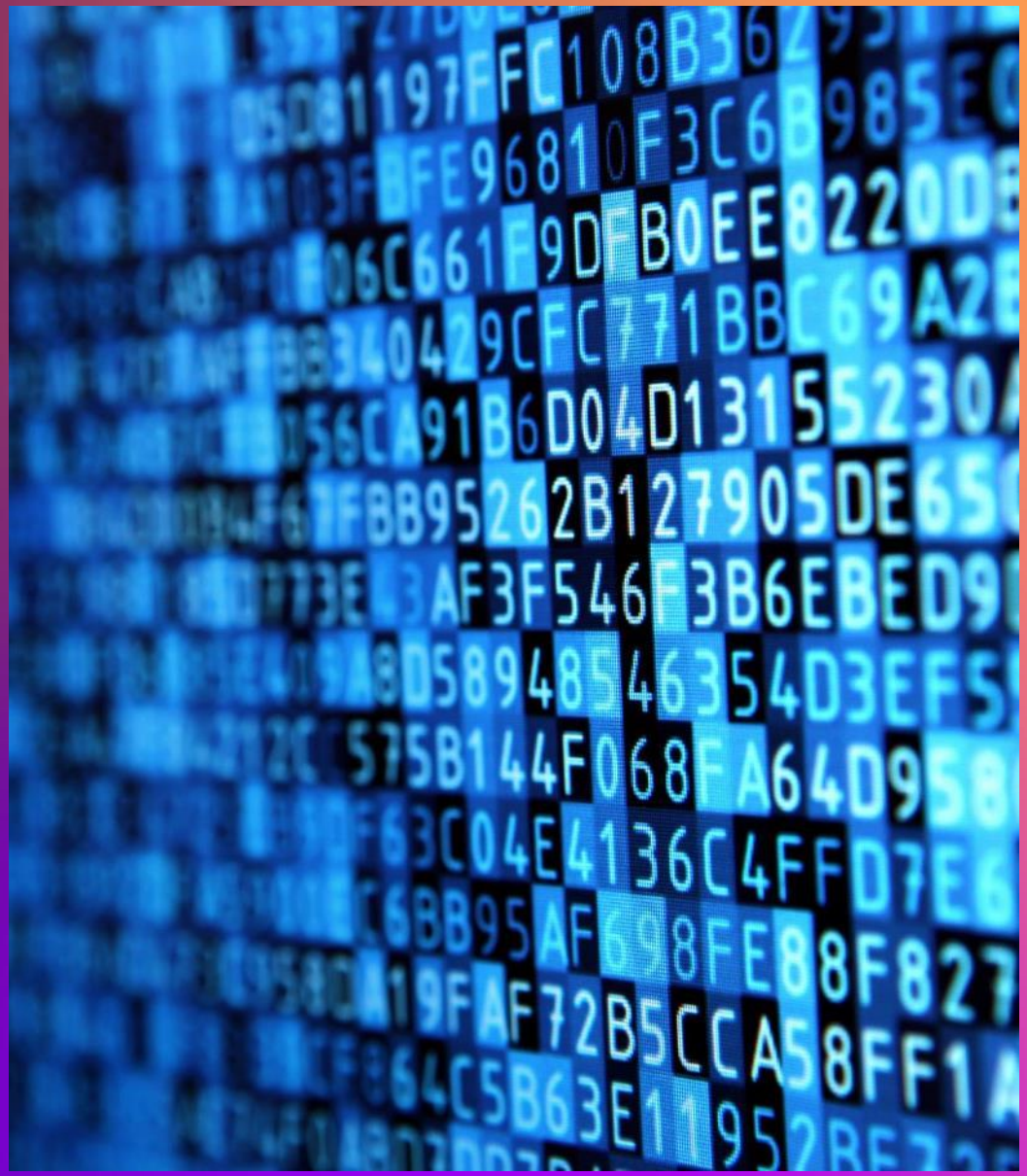
Note: Solution times are average by ticket type. A ticket type is such that holds the following characteristics constant throughout the analysis period: It is an incident of the same type and priority, originated in the same client's functional area, reported through the same channel and assigned to the same team. All models include fixed effects. Robust standard errors. *** p < 1%, ** p < 5%, * p < 10%.

RPA channels linked with fewer errors

	(1) Re-opened Tickets (%)	(2) Re-opened Tickets (%)
PRPA	**-0.0060 *** **	**-0.0063*** **
MRPA	0.0124	0.0113
ΔQTICKETS	-0.0026	-0.0034
SMAN	*Yes*	*No*
ERRORSini	*Yes*	*No*
Tenure	*Yes*	*No*
Age	*Yes*	*No*
Team Size	*Yes*	*No*
# Obs	1,336	1,336
FE by ticket	No	Yes

Note: Re-opening rates are averaged by ticket type. A ticket type is such that holds the following characteristics constant throughout the analysis period: It is an incident of the same type and priority, originated in the same client's functional area, reported through the same channel and assigned to the same team. Robust standard errors. *** p < 1%, ** p < 5%, * p < 10%.

Career Paths



Employee career path model

i: employees, j: team

$$Y_i = c_i + \beta_1 PRPA_j + \beta_2 MRPA_j + \beta_3 \Delta Qtickets_j + \beta_4 Soltime_j + \beta_4 MAN_j + \beta_5 HPERF_i + \beta_s X_j^s + \varepsilon_{ijt}$$

Y_i	Career outcome one year after RPA roll out: (1) Continues on project (2) Receives performance award at end of the year (3) % base salary increase
MAN_j	Managerial role
$HPERF_i$	Received performance-related award last year

RPA "selects in" high performers

	Continue on Project	Performance Award	Wage Change (%)
Continue		**0.7619****	**0.0211*****
HPERF	**0.8925****	0.2960	**0.0408****
PRPA	0.1119	-1.2096	0.0268
MRPA	-18.7668	-28.8876	1.5448
Δ*SOLTIME*	-2.4516	-2.7690	0.0408
Δ*QTICKETS*	-1.9241	-4.0603	0.2429
Man	-0.2922	-0.5608	-0.0317
# Obs	453	453	453

All regressions include controls for gender, age, education, industry specialty, career group, tenure, team size and other relevant team characteristics. Robust standard errors. *** p < 1%, ** p < 5%, * p < 10% .

What we have learnt

- Details Matter – Case Study/Workplace Setting, Specific Technologies, Workflow Intervention
- RPA boosts productivity by decreasing solution times & fewer errors, especially if complemented with human manager skills and more time demanding tickets
- No evidence of direct near-term impact on worker exits, pay or promotions
- But RPA is linked to the “selecting in” of high performers

QA