MBA753M

Causal Inference Methods for Business Analytics

Research Topic

Employee innovation during office work, work from home and hybrid work

About

- **Study:** examines the impact of three work modes on employee innovation:
  - Office Work (WFO)
  - Work from Home (WFH)
  - Hybrid Work

- **Research Context** - Focus on an Indian IT services company with data from over 48,000 employees.

- Innovation outcomes assessed based on:
  - **Quantity** of ideas generated
  - **Quality** of ideas submitted during these work modes.

Claim

WFH Impact

- There is **no significant change** in the quantity of ideas submitted during the period of study.
- Quality of ideas decreases during WFH, hence approval rate from clients decreased significantly.

Hybrid Impact

- Many firms are adopting a hybrid model in which employees work partly from the office and partly from home
- Both quantity and quality of ideas decline during hybrid mode.
- There is poor coordination between in-office and remote employees.

Abstract

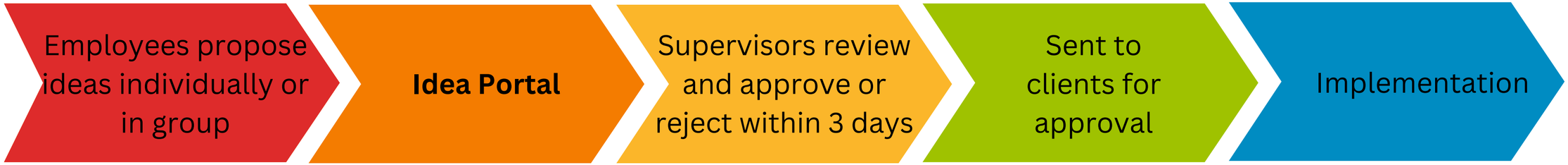
Pandemic Shift
Covid-19 led to rapid WFH adoption, evolving into hybrid work as the pandemic eased.

Concerns
Firms fear remote and hybrid work may harm innovation and effectiveness.

Study Objective
Empirical evidence on the impact of WFH and hybrid work on employee innovation.

Insights to Dataset

- **Dataset used**: HCL Technologies, one of the world's largest IT services companies, with headquarters in India
  HCL focuses on strategy emphasizing innovation for clients, unique in their ideas and more like long-term partners for clients.
  The subjects of our study are highly educated IT professionals – with degrees in an engineering field.



This system has been in place before the sample period and remains unchanged
Type of ideas considered -

- Process improvement (26.7%)
- Cost reduction (19.6%)
- Technical + Others (53.7%)

The sample period (2019-2022) covers three company-wide work modes: an abrupt switch to remote work during the Covid-19 pandemic, followed by a hybrid model as the pandemic eased.
Note: All employees **followed the same work mode** at any given time

Regression Equation

$$y_{it} = \alpha_i + \beta_1 \mathrm{WFH}_t + \beta_2 \mathrm{Hybrid}_t + \sum \gamma_j \mathrm{CustomerTeam}_{jit} + \sum \delta_s \mathrm{Month}_{st} + \zeta t + \varepsilon_{it},$$

α_i : employee fixed effect

WFH_t : 0/1, where 1 if month t is work from home

$Hybrid_t$: 0/1 where 1 if month t is hybrid work

$CustomerTeam_{jit}$: 0/1 where 1 if employee i was in team j in month t

$Month_{st}$: 0/1 where 1 if $Month_{1t} = Jan$, $Month_{2t} = Feb$ and so, on

t: Month

γ_j : coefficient for tong term time trend

ζ : coefficient for Month

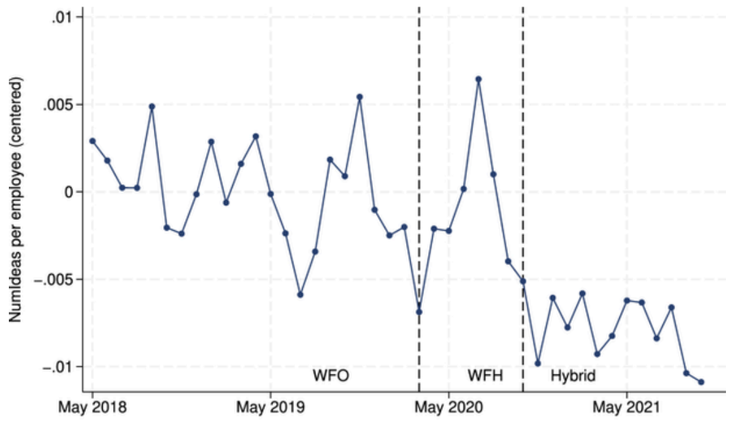
ε_{it}: Standard Error

Methods

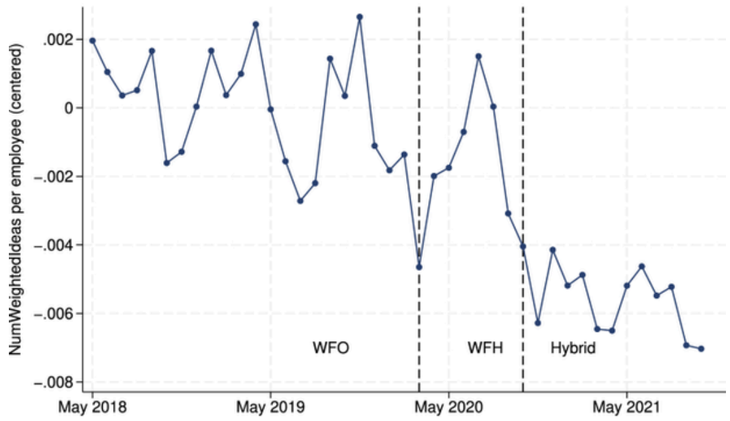
- Evaluation is done on two parameters ***Quantity*** and ***Quality*** of Ideas

1.Quantity

- Compared to WFO, quantity of idea submitted is nearly same in WFH however it drops significantly for Hybrid culture.
  Four parameters has been used in evaluations
  - NumIdeas: Total Number of ideas submitted (if coauthor it is counted as 1)
  - NumWeightedIdeas: Number of ideas submitted
    (if coauthored fraction contribution is considered)
  - NumIdeasMS3: three-month moving sum of NumIdeas
  - NumWeightedIdeasMS3: three-month moving sum of NumWeightedIdeas



(a) No weighting by number of idea authors



(b) With weighting by number of idea authors

	(1)	(2)	(3)	(4)
Dependent variable	**NumIdeas**	**NumWeightedIdeas**	**NumIdeasMS3**	**NumWeightedIdeasMS3**
WFH	0.001	−0.000	0.005	−0.000
	(0.001)	(0.000)	(0.004)	(0.002)
Hybrid	−0.006***	−0.004***	−0.024***	−0.016***
	(0.001)	(0.001)	(0.003)	(0.002)
Employee FE	Yes	Yes	Yes	Yes
Team FE	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes
Linear time trend	Yes	Yes	Yes	Yes
Test WFH = Hybrid (p-value)	0.000	0.000	0.000	0.000
WFO Mean	0.009	0.006	0.030	0.018
Observations	1060648	1060648	867234	867234
Clusters	48110	48110	44453	44453

- In the table coefficients of WFH values are nearly zeros however for Hybrid they are negative and statically significant.

- Looking WFO mean average for submission of one Idea takes 1/0.009 = 111 months (~9 years)
  In Hybrid employees generated 0.006 ideas per month on average, which corresponds to 143 months (~12 years) indicating a drop of 22% of ideas per employee per month in Hybrid mode

2. Quality

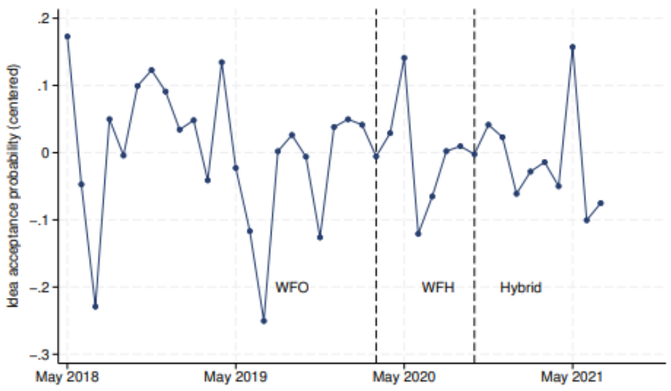
- Three measures has been used
  1. IdeaAccepted : 0/1, 1 for proposed idea accepted for implementation, 0 otherwise
  2. ClientShared : 0/1, 1 for idea shared 0 otherwise
  3. ClientApproval : 0/1 , 1 if idea gor a rating of 3 or 4 (1-4 scale) fom clients, elswhere 0

	(1)	(2)	(3)
Dependent variable	**IdeaAccepted**	**ClientShared**	**ClientApproval**
WFH	−0.067	−0.090**	−0.183**
	(0.051)	(0.045)	(0.090)
Hybrid	−0.062	−0.001	−0.176
	(0.075)	(0.064)	(0.119)
All ideas finished review	Yes	Yes	Yes
Author-Team FE	Yes	Yes	Yes
Month FE	Yes	Yes	Yes
Linear time trend	Yes	Yes	Yes
Test WFH = Hybrid (p-value)	0.917	0.117	0.934
WFO Mean	0.867	0.926	0.636
Observations	2898	2656	2898
Clusters	2069	1910	2069

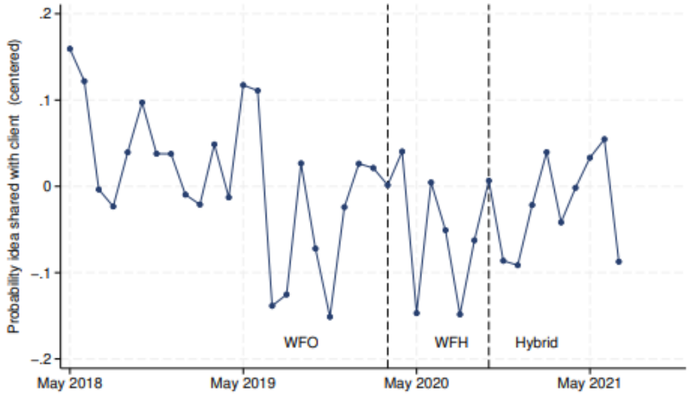
- For WFH all the negative coeff shows, Quality of Ideas falls down in this mode
- Probability of accepting a suggested idea is 6.7% lower in WFH and 6.2% lower in Hybrid, compared to WFO ideas (Column 1)

Robustness Checks

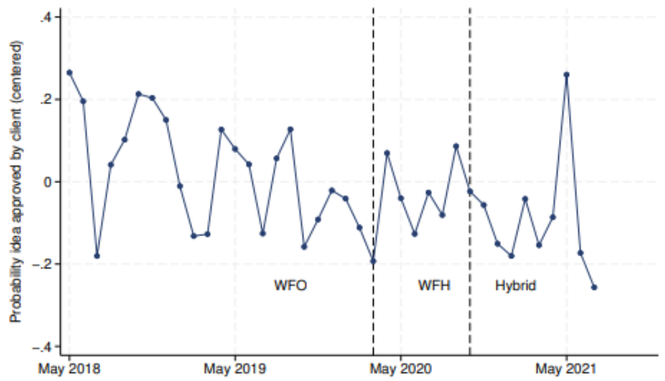
- The following different checks were considered for the robustness analysis though the results remained significantly the same-
  1. A quadratic time trend considered instead of linear trend
  2. Dropped the 0.1% of outcomes to investigate the sensitivity of the results of outliers
  3. Outcome variables lagged by 1 or 2 months since only date of idea submission was considered and not of idea generation which might have been in a different work mode
  4. Considered the effect on single and multi authored ideas to ensure whether ideas are mostly driven by collaboration only
  5. Considered the different demographics(age, gender, experience, etc.) separately



(a) IdeaAccepted



(b) ClientShared



(c) ClientApproval

Flaws in Experiment Design

- Focusing solely on a single company may not reflect the true picture
  - The study focused exclusively on HCL Technologies; so the causal claim may be valid only for that specific company, and change when we study other IT firms
  - The study can be repeated with other IT firms, one at a time (to maintain ceteris paribus), and verify if the causal claim still holds.

- Ceteris Paribus Assumption
  - Though the event study design compares work modes, it remains vulnerable to confounding variables
  - For example, changes in the external market conditions, boom in GenAI etc. during the pandemic might affect the outcome of our experiment

Potential Model Flaws

- No reference regarding Model Diagnostics
  - An **event study model** was applied to the data of IT employees
  - Since event study models use time series data, they are susceptible to autocorrelation issues
  - OLS assumes that the error terms associated with each observation are uncorrelated
  - If significant autocorrelation is present, OLS estimation becomes unreliable
  - **Residuals plot** and **Durbin-Watson test** can help address this issue

- The paper makes **no mention** of model diagnostics, leaving it unclear whether they were performed or not

- Conducting model diagnostics allows us to evaluate our claim and verify if the claim made is really causal in nature or not

Conclusions

1. **Innovation Quantity:**
- WFH: Employees submitted the same number of ideas as in the office.
- Hybrid: The number of ideas dropped significantly.

2. **Innovation Quality:**
- WFH: Idea quality was lower than in-office submissions.
- Hybrid: Quality remained stable despite fewer ideas.

3. **Collaboration Challenges:**
- Casual, spontaneous interactions were reduced in both WFH and hybrid setups, impacting creativity.
- Collaboration in hybrid teams was especially difficult.

4. **Hybrid-Specific Issues:**
- Inconsistent office attendance hindered spontaneous discussions and reduced innovation.

5. **Solutions for Firms:**
- Strategies like fixed office days or better coordination can help maintain collaboration and innovation.

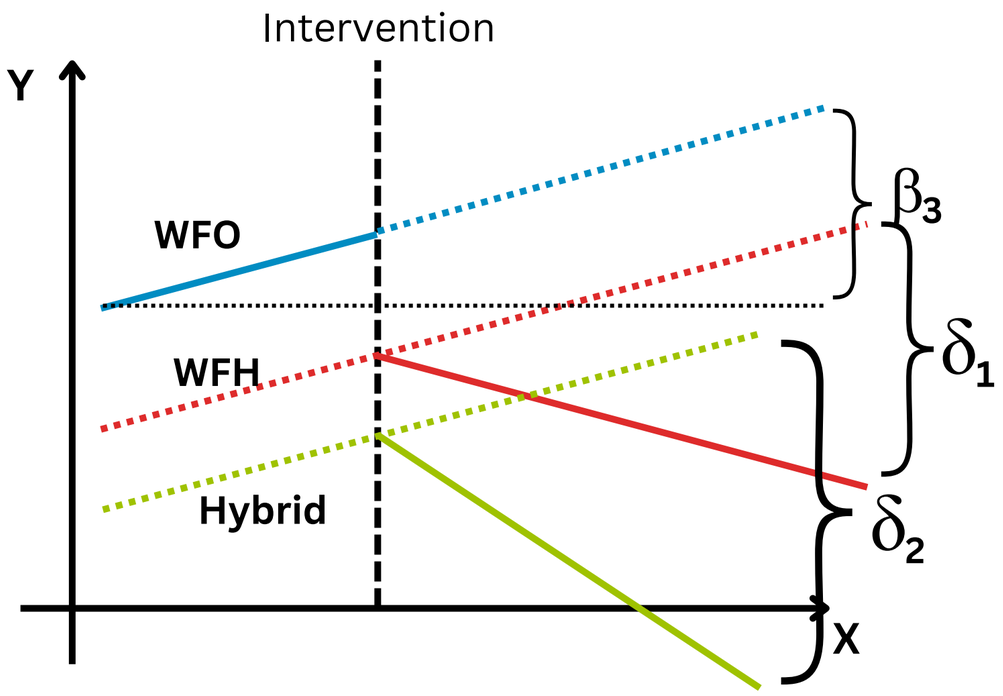
6. **Long-Term:**
- WFH and hybrid work offer flexibility but also risk weakening innovation unless carefully managed.

Alternate Approach

- **Difference-in-Differences Method** can be employed to study this problem

$$Y_{it} = \alpha + \beta_1 \text{WFH}_i + \beta_2 \text{Hybrid}_i + \beta_3 \text{Post}_t + \delta_1(\text{WFH}_i \times \text{Post}_t) + \delta_2(\text{Hybrid}_i \times \text{Post}_t) + \gamma X_{it} + \epsilon_{it}$$

where,
Yit : is the outcome for employee i in time period t (e.g., NumIdeas, IdeaAccepted).
α : is the constant term.
β1 and β2 capture the direct effect of WFH and Hybrid before the policy change.
β3 measures the time-specific effect (common shock affecting both WFH and WFO groups).
δ1 and δ2 are the DID coefficients, capturing the impact of WFH and Hybrid post-policy change on innovation.
Xit Variable for month
ϵit is the error term.



Interpretation:
δ1: The average treatment effect of WFH on innovation, post-policy implementation.
δ2: The average treatment effect of the hybrid work model on innovation, post-policy implementation.

Additional Considerations:

- **Parallel Trends Assumption**: Ensure that, before the implementation of WFH or Hybrid policies, innovation trends between the treatment (WFH, Hybrid) and control (WFO) groups were parallel.
- **Coordination Index**: To capture the team coordination issues mentioned in the study, an additional variable could be created to measure how often teams overlap in their in-office time or are synchronized in their hybrid schedules or consider the interaction term of coordination and hybrid variable to see how team presence variations affect innovation.

Thank You

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