Impacts of COVID-19 related Work-at-Home Policies on Systems Engineers and the General Population

Sponsor: SERC | INCOSE

Dr. José Ramírez-Márquez

12th Annual SERC Sponsor Research Review
HOSTED VIRTUALLY ON: November 18, 2020
www.sercuarcc.org
1. Introduction

2. Literature review

3. Methods
   — Survey
     o Multiple Choice Questions
     o Testimonial Answers
   — Twitter Conversational Approach
   — Reddit Testimonial Approach

4. Analysis
• Introduction

— Through the SERC survey understand the impact of COVID-19 on the Systems Engineering community given “stay at home” policies that have forced and accelerated work-at-home arrangements. Furthermore, the study will use social media data (Twitter and Reddit) to compare, leverage and contrast the Systems Engineering community behavior with other population cohorts.
• Methods
  —Survey
    o The Systems Engineering Research Center (SERC) and INCOSE with the interest of understanding the impact of COVID-19 within the SE community conducted a survey that was shared with around 10,000 participants and responded by roughly 600 participants with 80% answering completely.
    o The questions were divided into multiple choice and open answers’ questions. For the open answers text-mining techniques were applied (LDA algorithm).
    o There were multiple options for primary affiliation of the participants, but for general analysis 2 groups have been considered: Academia and Government-Industry.
Survey - Multiple Choice Questions

Primary Affiliation of Participants

How often were you working remotely prior to COVID-19?

How have any significant team projects in your environment transitioned in the face of shelter in place policies due to COVID-19?
Survey - Multiple Choice Questions

Negative Effects

How has working remotely negatively impacted your team's internal communication on projects?

- **Academia**
  - No impact at all, it has improved: 0%
  - No impact, it is as before: 40%
  - Small impact, still adjusting: 40%
  - Large impact, it hasn't worked: 20%

- **Industry - Government**
  - No impact at all, it has improved: 40%
  - No impact, it is as before: 20%
  - Small impact, still adjusting: 0%
  - Large impact, it hasn't worked: 0%

What is the negative impact of the COVID-19 situation on your work project(s)?

- **Academia**
  - Small Impact: 0%
  - Medium Impact: 40%
  - Large Impact: 20%

- **Industry - Government**
  - Small Impact: 40%
  - Medium Impact: 20%
  - Large Impact: 0%
• **Survey - Multiple Choice Questions**

**Changes**

**How did supervision and management change?**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>% Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academia</td>
<td></td>
</tr>
<tr>
<td>Industry - Government</td>
<td></td>
</tr>
</tbody>
</table>

**How did leadership change?**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>% Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academia</td>
<td></td>
</tr>
<tr>
<td>Industry - Government</td>
<td></td>
</tr>
</tbody>
</table>

Small Impact → High Impact
• Survey - Multiple Choice Questions

Challenges (Quantitative Answers)

What challenges are you facing working from home? (Choose all that apply)

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Academy</th>
<th>Industry - Gov.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distractions at home</td>
<td>39%</td>
<td>32%</td>
</tr>
<tr>
<td>More difficult to coordinate meeting/interactive times with others</td>
<td>27%</td>
<td>29%</td>
</tr>
<tr>
<td>No significant challenges</td>
<td>28%</td>
<td>22%</td>
</tr>
<tr>
<td>Remaining motivated during work hours</td>
<td>27%</td>
<td>23%</td>
</tr>
<tr>
<td>Internet bandwidth limitations</td>
<td>22%</td>
<td>24%</td>
</tr>
<tr>
<td>Unable to access sensitive/restricted/classified information</td>
<td>7%</td>
<td>33%</td>
</tr>
<tr>
<td>Limitations from my IT/Computer setup</td>
<td>13%</td>
<td>20%</td>
</tr>
<tr>
<td>Poor or distracting workspace setup</td>
<td>16%</td>
<td>14%</td>
</tr>
<tr>
<td>Unable to easily access necessary tools</td>
<td>13%</td>
<td>15%</td>
</tr>
<tr>
<td>Childcare/Daycare/School</td>
<td>16%</td>
<td>12%</td>
</tr>
<tr>
<td>Unable to easily access necessary information</td>
<td>11%</td>
<td>12%</td>
</tr>
</tbody>
</table>

How is your employer supporting you to work remotely? (Choose all that apply)

<table>
<thead>
<tr>
<th>Support</th>
<th>Academy</th>
<th>Industry - Gov.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provides on-line collaboration tools</td>
<td>73%</td>
<td>77%</td>
</tr>
<tr>
<td>Provides a laptop/computer to work remotely</td>
<td>62%</td>
<td>84%</td>
</tr>
<tr>
<td>Supports a safe way to visit my office to collect needed resources</td>
<td>29%</td>
<td>51%</td>
</tr>
<tr>
<td>Provides home office setup (e.g., monitor, printer)</td>
<td>16%</td>
<td>23%</td>
</tr>
</tbody>
</table>

What impact has the COVID-19 crisis had on the following: (selection of 1-5 above for each)

<table>
<thead>
<tr>
<th>Impact</th>
<th>Industry - Government</th>
<th>Industry</th>
<th>Government</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to documents/files required to do your job</td>
<td>No negative impact 36%</td>
<td>Little negative impact 25%</td>
<td>Neutral 14%</td>
</tr>
<tr>
<td>Access to software, tools, devices required to do your job</td>
<td>No negative impact 41%</td>
<td>Little negative impact 23%</td>
<td>Neutral 14%</td>
</tr>
<tr>
<td>Availability of workforce</td>
<td>No negative impact 18%</td>
<td>Little negative impact 26%</td>
<td>Neutral 13%</td>
</tr>
<tr>
<td>Clarity of information from leadership</td>
<td>No negative impact 39%</td>
<td>Little negative impact 23%</td>
<td>Neutral 19%</td>
</tr>
<tr>
<td>Project expectations (schedules, reviews, etc.)</td>
<td>No negative impact 17%</td>
<td>Little negative impact 27%</td>
<td>Neutral 13%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Impact</th>
<th>Academia</th>
<th>Industry</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to documents/files required to do your job</td>
<td>No negative impact 36%</td>
<td>Little negative impact 28%</td>
<td>Neutral 16%</td>
</tr>
<tr>
<td>Access to software, tools, devices required to do your job</td>
<td>No negative impact 51%</td>
<td>Little negative impact 22%</td>
<td>Neutral 11%</td>
</tr>
<tr>
<td>Availability of workforce</td>
<td>No negative impact 26%</td>
<td>Little negative impact 28%</td>
<td>Neutral 19%</td>
</tr>
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</tr>
</tbody>
</table>
• Survey - Multiple Choice Questions

What challenges are you facing working from home? (Choose all that apply)

- Distractions
- Childcare/School
- Workspace setup
- Motivation during work
- Coordination
- Internet bandwidth
- Necessary tools
- Necessary information
- Restricted information
- IT/Computer setup

Matrix showing the relationship between different challenges.
### Survey - Multiple Choice Questions

#### Remote Work Tools

For each of the following tools, indicate your interest in using this tool in the future, if available to you:

<table>
<thead>
<tr>
<th></th>
<th>Industry - Government</th>
<th>Academia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No interest</td>
<td>Little interest</td>
</tr>
</tbody>
</table>
| Adobe Connect        | 30%     | 9%      | 14%       | 5%            | 41%
| GlobalMeet           | 33%     | 10%     | 14%       | 4%            | 39%
| Microsoft Teams      | 11%     | 7%      | 35%       | 24%           | 23%
| Skype for Business   | 16%     | 12%     | 34%       | 15%           | 23%
| Slack                | 25%     | 9%      | 23%       | 7%            | 36%
| WebEx                | 17%     | 12%     | 36%       | 14%           | 24%
| Zoom                 | 16%     | 11%     | 30%       | 18%           | 26%

#### Online Collaboration Tools Satisfaction Level

For each of the following online collaboration tools that you currently use, please indicate your overall satisfaction level:

<table>
<thead>
<tr>
<th></th>
<th>Industry - Government</th>
<th>Academia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Very poor</td>
<td>Poor</td>
</tr>
</tbody>
</table>
| Adobe Connect        | 1%        | 2%   | 4%   | 5%   | 3%        | 85%
| Collaborative modeling tools | 0%    | 1%   | 5%   | 10%  | 4%        | 79%
| GlobalMeet           | 1%        | 3%   | 7%   | 8%   | 2%        | 78%
| Microsoft Teams      | 1%        | 3%   | 8%   | 20%  | 21%       | 41%
| Skype for Business   | 2%        | 4%   | 19%  | 31%  | 21%       | 24%
| Slack                | 1%        | 0%   | 4%   | 12%  | 3%        | 79%
| Virtual Private Networking (VPN) and remote desktop tools | 1% | 5% | 13% | 30% | 36% | 16%
| Virtual whiteboarding tools | 1% | 2% | 6% | 5% | 4% | 83%
| WebEx                | 1%        | 7%   | 15%  | 36%  | 14%       | 27%
| Zoom                 | 1%        | 4%   | 10%  | 30%  | 22%       | 32%

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SSRR 2020

November 18, 2020
• Survey – Testimonial Answers

— Answers were divided in 3 groups considering their sentiment:
  o **Positive-oriented** questions: 610 answers
    — What aspects got better?
    — What is better now from management since sheltering in place?
  o **Neutral-oriented** questions: 536 answers
    — Describe what has changed
    — Describe what has changed
    — What aspects of leadership do you value more as a result of COVID19 related constraints?
  o **Negative-oriented** questions: 1332 answers
    — What aspects of your project(s) suffered?
    — What was better from management prior to COVID 19?
    — What other issues are you facing as a result of the COVID-19 crisis?
    — What long-term impacts do you expect as a result of the COVID-19 crisis?
Survey – Testimonial Answers

Positive Questions

- “accepting a lot of work done remotely”
- “better balance of work and family”

Neutral Questions

- “little communication”
- “frequent update situation developed”

Negative Questions

- “collaboration become difficult”
- “nothing really”
• Survey – Testimonial Answers

• To simplify the understanding of the text extracted from the testimonial answers, we used the topic modeling technique LDA (Latent Dirichlet Allocation).

• LDA’s enables the efficient processing of an extensive collection of texts, finding frequent descriptions that groups as topics.

• LDA assigns a value between zero and one to each text (answer), representing how much is related to the corresponding topic.
• LDA Algorithm
  – Assumes a fixed number of topics
  – Clusters words co-occurred in similar documents
  – Provide a word distribution for each topic; and a topics distribution for each documents
  – It *can’t* choose a *title* for the topics
Distribution of words in vocab over topics

Distribution of words in documents

Distribution of topics over document

\[ \theta_{dk} \]

\[ Z_{dn} = \{1, \ldots, K\} \]

\[ \beta_{ki} = \{1, \ldots, K\} \]
**Survey – Testimonial Answers**

**Cluster 1: Work-life balance**

- Work-life balance improved
- Easier to focus
- Better productivity

**Cluster 2: Time waste**

- Work with less distractions
- Reduced time waste on commute travels
- Fewer unnecessary meetings
• Survey – Testimonial Answers

Cluster 3: Team work

Top-30 Most Relevant Terms for Topic 2 (27.7% of tokens)

- Better collaboration
- New communication and collaborative tools
- Team daily meetings
Survey – Testimonial Answers

Cluster 4: Management changes

- There have been changes in management:
  - team meetings
  - people (managers) laid off

Cluster 5: Communication changes

- Less face to face meetings
- Need of leadership skills
- Increase use of email as communication tool
• Survey – Testimonial Answers

Cluster 6: Less interaction & social isolation

- Less interaction
- Social isolation
- Less social activities
- Lack of face-to-face meetings
- Canceled work travels

Cluster 7: Collaborative work issues

- Matching schedules difficulties
- Problems accessing restricted information
- Personal contact issues
Survey – Testimonial Answers

Cluster 8: Economy impact

Top-30 Most Relevant Terms for Topic 3 (22.3% of tokens)

- Change in business and recruiting workflow
- Impact on overall economy
• **Survey – Testimonial Answers**

<table>
<thead>
<tr>
<th>GROUP</th>
<th>CLUSTER</th>
<th>NAME</th>
<th>MAIN WORDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>1</td>
<td>Work-life balance</td>
<td>nothing, work, team, focus, better, time, much, project, productivity, travel</td>
</tr>
<tr>
<td>Positive</td>
<td>2</td>
<td>Time waste</td>
<td>meeting, time, none, commute, work, fewer, focused, management, focus, home</td>
</tr>
<tr>
<td>Positive</td>
<td>3</td>
<td>Team work</td>
<td>work, meeting, communication, people, team, working, remote, remotely, time, home</td>
</tr>
<tr>
<td>Neutral</td>
<td>4</td>
<td>Management changes</td>
<td>team, management, meeting, communication, focus, update, covid, working, email, information</td>
</tr>
<tr>
<td>Neutral</td>
<td>5</td>
<td>Communication changes</td>
<td>communication, nothing, face, leadership, work, meeting, team, management, increased, now</td>
</tr>
<tr>
<td>Negative</td>
<td>6</td>
<td>Less interaction</td>
<td>meeting, work, time, collaboration, face, home, facetoface, nothing, travel, office</td>
</tr>
<tr>
<td>Negative</td>
<td>7</td>
<td>Collaborative work issues</td>
<td>communication, team, schedule, new, face, office, access, working, meeting, personal</td>
</tr>
<tr>
<td>Negative</td>
<td>8</td>
<td>Economy impact</td>
<td>work, access, person, project, home, management, working, impact, change, people</td>
</tr>
</tbody>
</table>
• Comparing the Survey results with Twitter data

Data Collection using Twitter API

(1) Collecting the core using proper hashtags
(2) Extending the dataset to get the replies

Clustering the tweets into different categories

Select clusters related to survey questions

Measure sentiment affiliated with common phrases

- Asynchronous communication
- No need to commute
- Deep work
- Self isolation
- Internet connection
- Zoom fatigue

Bind phrases to generate pos/neg aspects

1) Flexibility
2) Saving time
3) Deep work
1) Isolation
2) Distraction
3) Tech issues
Step 1.- Data Collection

1. All the tweets posted in 2020 that with the following hashtags were collected:

#remotework, #workathome, #workfromhome, #wfh, #homeoffice, #virtualmeetings, #freelancer, #digitalnomad

In total over 5 million tweets from almost 866,000 users were collected.

1. Dataset was extended to include the replies:

   Why? Central tweets are mainly news and advertisements shared in Twitter and personal viewpoints are mostly extractable from the discussions around them.
Step 2 & 3. Clustering the tweets/ select relevant clusters

1. A deep learning algorithm is used to divide all the tweets into different clusters

2. The relevant clusters to the survey are as follows:
   - WFH communication tools
   - Cloud services
   - Remote team collaboration
   - WFH experience sharing
   - Physical and emotional health
   - WFH in Academia
   - Improving life environment during WFH

The remaining clusters are about job offers, news, motivations and tips, news, economy reopen, digital nomad, and announcements. These clusters are filtered out.

Main keywords for each cluster are reported in the next two slides.
<table>
<thead>
<tr>
<th>Clusters</th>
<th>Keywords</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>WFH job offer: available, registration, send, detail, apply, limited, earning, info, visit, service, sign, request, fee, coverage, furlough</td>
<td>3.25%</td>
</tr>
<tr>
<td>2</td>
<td>WFH tips and motivations: #stayathome, #stayhomesavelives, covid-19, quarantineandchill, washyourhands, #stayconnected, #stopthespread, Mondaymotivation, social distancing, self-isolation, #inthistogether, #shelterinplace, #workingfromhometips, the new normal</td>
<td>26.5%</td>
</tr>
<tr>
<td>3</td>
<td>WFH communication tools: iPad, laptop, printer, cable, microphone, mic, display, webcam, camera, audio, portable, MacBook, headset, notebook, tablet, storage, whiteboard, workstation, install, slide, adjustable, adobe, feature, functionality, setup, screen, design, deployment, browser, mobile, reliable, application, wireless, router, hardware, vpn</td>
<td>1.8%</td>
</tr>
<tr>
<td>4</td>
<td>Improving life environment during WFH: house, cozy, bedroom, kitchen, desk, chair, couch, furniture, wall, floor, apartment, air, décor, sunshine, painting, white, black, natural lighting, warm, weather, cleaning, outdoor, walk, park, trip, backyard, garden, tree, plant, cake, cup, mug, coffee, tea, chocolate, breakfast, drink, snack</td>
<td>4.9%</td>
</tr>
<tr>
<td>5</td>
<td>WFH experience sharing: doubt, I’m saying, tired, literally, mute, forgot, assume, gonna cry, cause, workload, complaint, stressful, tired, surprised, agree, realized, attention, I’m glad, husband, wife, willing, lazy, joke</td>
<td>5%</td>
</tr>
<tr>
<td>6</td>
<td>WFH in Academia: coordinator, graduate, associate, junior, advisor, academic, intern, clinical, mentor, field, recruiter, international students, faculty, volunteer, university, trainer, internship, position, medical insurance, administration, loan, college, admin, payroll, tutor, educational, jobseekers, program, researcher, expertise resume, cv</td>
<td>2.3%</td>
</tr>
<tr>
<td>7</td>
<td>Reopening economies: government, reopening, accelerating, prediction, expected, future, affected, impact, recovery, economy, forcing, concern, emerging, implication, catalyst, scenario, surge</td>
<td>3.8%</td>
</tr>
<tr>
<td>8</td>
<td>Remote team collaboration: collaborative, effective strategy, approach, team culture, team work, distributed team, adapt, communicate, structure, develop, design, create, relationship, teammate, leading, communicating tool, creativity, leader, workspace, mindset, dynamic, shared, motivate, innovative, communication, workflow, manage, adapting, practical, productively, agile, asynchronous communication, efficient, tactic, partnership, challenging, toolkit, Atlassian, workforce, hybrid, company culture, distributed teams, workplace, engagement</td>
<td>11.3%</td>
</tr>
<tr>
<td>9</td>
<td>WFH news</td>
<td>report, trending, magazine, newsletter, announces, published, release, statistic, phishing, scam, silicon valley, CNBC, Bloomberg, ZDNet, BBC, CNN, WSJ, businessinsider, nytimes, hacker news, TechCrunch, business insider, press, techradar</td>
</tr>
<tr>
<td>10</td>
<td>WFH CS Job offers (Computer Science)</td>
<td>Job, #hiringnow, #remotejob, #workfromhomejobs, fulltime, apply now, senior, fullstack programmer, hiringnow, apply, Software development, consultant, machine learning, gamedev, data science, salesforce, engineering jobs, android, recruiting, Ruby, SQL, Java, Python, PHP, developer, docker, Linux, AWS, Github, Golang, web development</td>
</tr>
<tr>
<td>11</td>
<td>Cloud services</td>
<td>remote access, hub, cloud computing, mobility, governance, accessibility, visibility, IT support backup, vmware, data breach, zero-trust, digitalworkplace, AI, datasecurity, #futureofwork, virtual work, distributed teams, video conferencing, cisco, virtual meetings, IT security, data protection, cloud security, telework, hrtech, zoom meeting, video conference, authentication, VPN, Azure, SD-WAN, Citrix, CTO, IBM, Gartner, privacy, cyberattack, malware, 5G, remote access, SMB, zdnet</td>
</tr>
<tr>
<td>12</td>
<td>Home-based business job offers</td>
<td>side hustle, influencer, get paid, homebiz, #makingmoney, #businessopportunity, online business, #makemoneyfromhome, digital marketing, online marketing, earnmoneyfast, entrepreneurlife, passive income, businesswoman, clickbank, blogging, marketingstrategy, #homebasedbusiness, extraincome, Pinterest, earnmoneyonline, financialfreedom, businessowner, #makemoneyathome, #makemoneyonline, cash, profitable, paypal, recession, residualincome, selfemployed, entrepreneurship, mompreneur, cryptocurrency, stockmarket, Forex, trader, bitcoin, commission</td>
</tr>
<tr>
<td>13</td>
<td>Digital nomad</td>
<td>sunshine, sky, sunny, tree, rain, mountain, arrived, homemade, hill, wow, beach, driving car, park, bike, fuel, coast, imagine, earth, weather</td>
</tr>
<tr>
<td>14</td>
<td>Meeting/seminar Announcement</td>
<td>upcoming, tomorrow, participants, session, discussing, hosting, hosted, attend, speaker, registration, discussion, meetup, guest, panel, joining, featuring, webinar, date, webcast, joined, event, presenting, summit, register, Eventbrite, ticket, interactive, series, join, live, speaking, March, spotlight, icymi, calendar, welcome, recording, missed, episode, workshop, announce, launched, reminder, weekly, April, August, June, July, today, Monday, Thursday, Tuesday, Wednesday, Friday, est, pst</td>
</tr>
<tr>
<td>15</td>
<td>Physical and emotional health</td>
<td>attitude, #worklifebalance, ergonomics, anxiety, mental health, pressure, lonely, challenging, pain, practical guideline, fitness, meditation, #healthylifestyle, hygiene, eating, exercise, workout, selfcare stressful, feeling, wellbeing, loneliness, emotional, isolation, prevent, routine, practicing, distraction, fatigue, stay calm, cope, relax, parenting, family, child, kid, homeschooling</td>
</tr>
</tbody>
</table>
Step 4.- Measure sentiment affiliated with common phrases

1. Using sentiment analysis to selected tweets are divide the tweets into 3 categories:
   positive sentiment 57%
   negative sentiment 23%
   neutral (mainly news, reports, recommendations) 20%

2. The most recurrent phrases in the tweet with negative sentiment and positive sentiment are extracted and then binded to represent a salient aspect: flexibility, isolation, tech issues, etc.
• Overall Sentiment for some Negatively discussed Phrases
Step 5.- Bind phrases to generate pos/neg aspects

—Negative Aspects (1):

1. Isolation (social isolation, self isolation)
   Sense of isolation is reported as the mere significant drawback of remote work experience.
   Ex: “I’m all for the remote work so I could not come up with more than one cons: Isolation.”

2. Distraction (home environment, etc.)
   Ex: “I need somewhere to go all day that doesn't carry the normal distractions of home: kids, "I should clean that", etc.”
Step 5.- Bind phrases to generate pos/neg aspects
—Negative Aspects (2):

3. Tech issues (Internet connection, Zoom fatigue, echo sound)

Over Usage Ex: “But if you're on Zoom so much that you're constantly Zoom-fatigued, your bigger problem might be you've got too many meetings.”

Misusage Ex: “Of all the things that's going to drive me insane during remote work isolation, it's people's inability to differentiate between the 'Posts' feature and 'Chat’ feature on Microsoft Teams.”
Step 5.- **Bind phrases to generate pos/neg aspects**

— Positive Aspects (1):

1. **Flexibility (Life balance, Flexible work)**

   Flexibility is the most discussed positive aspect of remote working.

   Ex1: “less commute more deep work and a better work life balance”

   Ex2: “Remote work done well creates the advantage for humans that express themselves well in writing (asynchronous communication) and by speaking (clear agendas, less on the fly planning).”
Step 5.- Bind phrases to generate pos/neg aspects

— Positive Aspects (1):

2. Saving time (Traffic, commute, etc.)
Ex: “I haven't sat in traffic for more than 2-3 minutes since I started remote work, don't miss it.”

3. Deep work (Asynchronous communication, etc.)
Ex: I would build off of that and say, the transition from in-person to remote work done well creates the advantage for humans that express themselves well in writing (asynchronous communication) and by speaking (clear agendas, less on the fly planning)