



@margaretstorey

# *What does 'developer productivity' actually mean?*

It Will Never Work in Theory: Live!



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*Acknowledging* Tom Zimmermann, Brian Houck, Michaela Greiler, Jacek Czerwonka, Brendan Murphy, Chris Bird, Eirini Kalliamvakou, Courtney Miller, Denae Ford, Jenna Butler, Nicole Forsgren, Abi Noda, Arty Starr...



*If you want to liven up a **boring meeting** with software developers and their managers - just bring up the concept of developer productivity and suggest how it should be measured!*



# *What does 'developer productivity' mean to managers and developers?*



Storey, Houck, Zimmermann: How Developers and Managers Define and Trade Productivity for Quality. CHASE 2022.



*“Being able to get out of meetings with action items, and proper end result. Having the right folks in the room so that we can close on things and move on.”*

*“Tackle the **right problem** and get the job done efficiently & **high quality**”*

## Developer productivity according to *managers*...

*“People are able to predictably deliver features and fixes that keep our customers happy while learning and growing, constantly improving our culture, and staying happy themselves”*

# Productivity according to *developers*...

“*Percentage of my time* spent doing actual work.”

“Achieving current *sprint deliverables*.”

“How much *impact* my work has.”

“Amount of useful ‘work’: feature implemented,  
customer issues resolved, *colleagues helped*...”

“I define productivity as how well I  
*felt engaged* in the work I am doing  
and how much I am *learning*.”



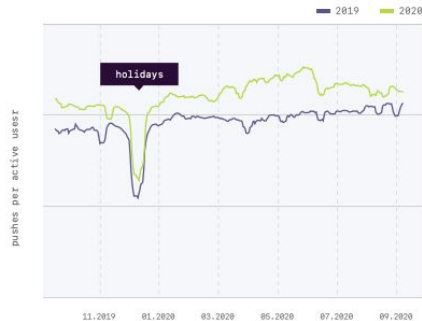


# Measuring productivity working from home: Seems ok?

Pull requests per active user, year-over-year comparison, seven-day rolling average



Push volume per active user, year-over-year comparison, seven-day rolling average



Forsgren: The State of the Octoverse Report 2020

## CHANGES IN PERCEIVED TEAM PRODUCTIVITY.

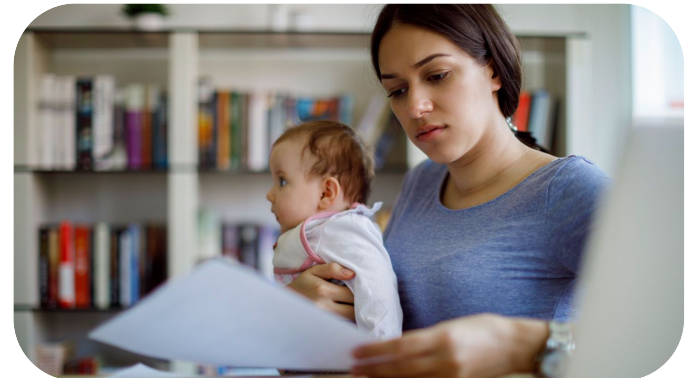
	WFH-Survey	Team-Survey
Significantly more productive	3%	2%
More productive	19%	18%
About the same	55%	56%
Less productive	21%	21%
Significantly less productive	2%	2%

Miller, Rodeghero, Storey, Ford, Zimmermann:  
"How Was Your Weekend?" Software Development Teams  
Working From Home During COVID-19. ICSE 2021

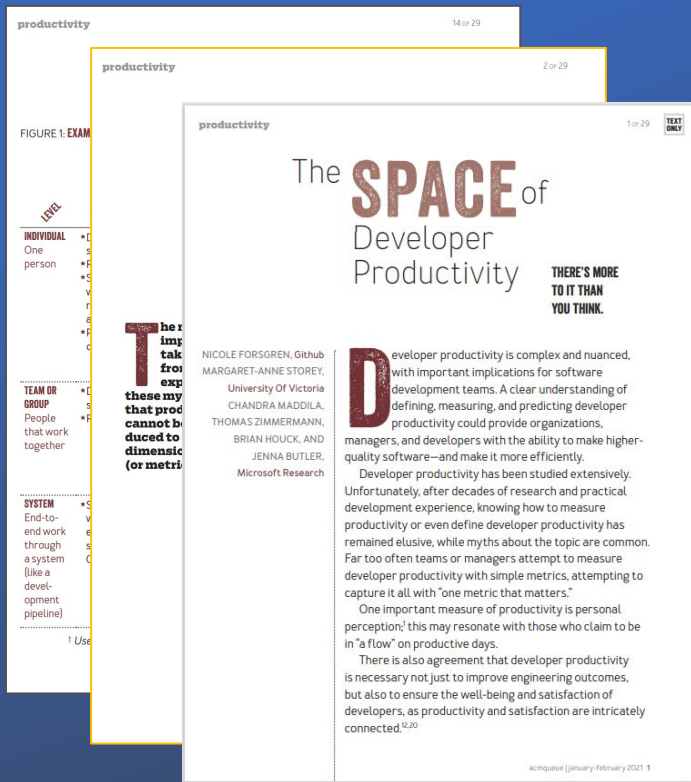
# It's more complicated than we may think...

*"I think we spend a lot **more time trying to coordinate** with each other and driving for clarity and **shared understanding is harder**. This means more time solidifying what we need to be doing and less time doing/building it."*

***Interruptions and concentration as I can [only] be reached on Teams and by email vs someone walking over for a question. Harder to keep tabs on direct reports.***



# SPACE: A framework for understanding productivity



S

Satisfaction and well-being

P

Performance

A

Activity

C

Communication and collaboration

E

Efficiency and flow

Forsgren, Storey, Maddila, Zimmermann, Houck, Butler:  
The SPACE of Developer Productivity. Commun. ACM 2021.



# SPACE: A framework for understanding productivity

S

Satisfaction and well-being

How fulfilled developers feel with their work, team, tools, or culture

P

Performance

How healthy and happy developers are

A

Activity

C

Communication and collaboration

E

Efficiency and flow

Storey, Zimmermann, Bird, Czerwonka, Murphy, Kalliamvakou: Towards a Theory of Software Developer Job Satisfaction and Perceived Productivity. IEEE TSE 2021.

# SPACE: A framework for understanding productivity

S

Satisfaction and well-being

P

Performance

A

Activity

C

Communication and collaboration

E

Efficiency and flow

The outcome of a system or process. Hard to quantify performance because there are so many variables

# SPACE: A framework for understanding productivity

S

Satisfaction and well-being

P

Performance

A

Activity

The number of actions or outputs completed while performing work

C

Communication and collaboration

E

Efficiency and flow

# SPACE: A framework for understanding productivity

S

Satisfaction and well-being

P

Performance

A

Activity

C

Communication and  
collaboration

How people and teams communicate and  
work together

E

Efficiency and flow

# SPACE: A framework for understanding productivity

S

Satisfaction and well-being

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Performance

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Activity

C

Communication and collaboration

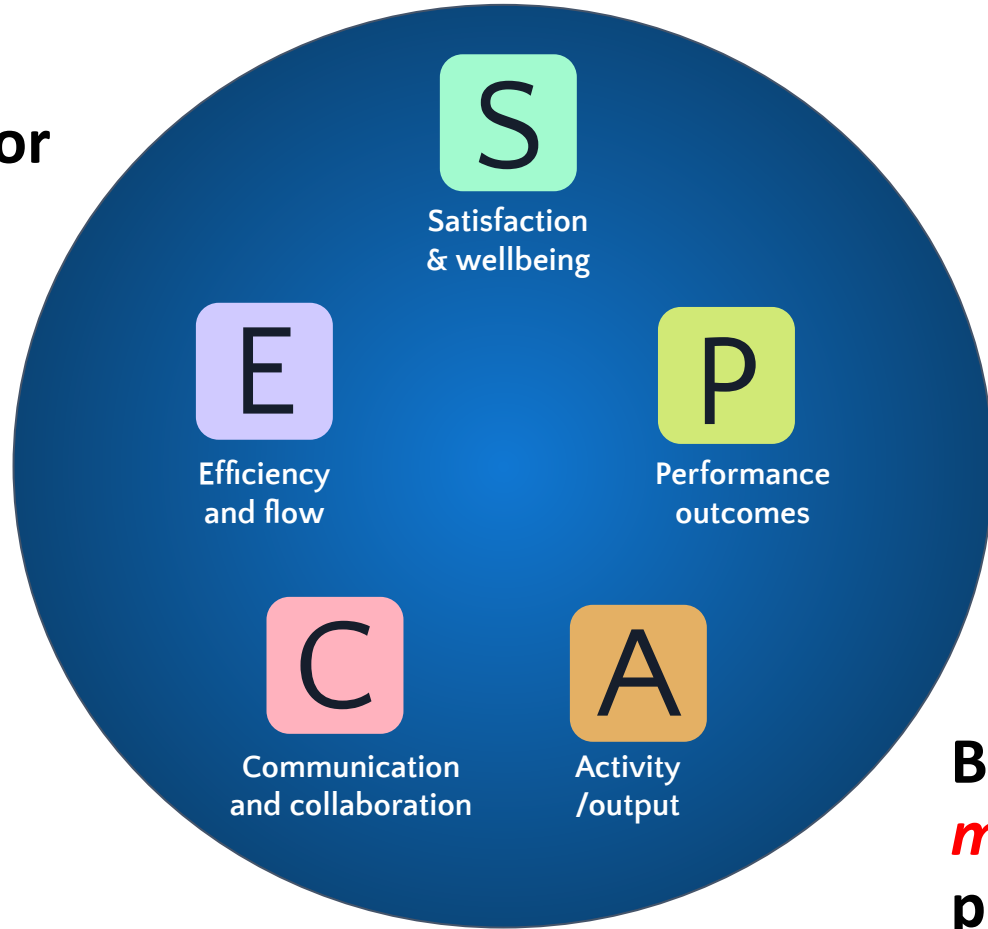
E

Efficiency and flow

How well developers and teams can make progress and complete work without interruptions or delays



**SPACE:**  
A framework for  
*understanding*  
productivity



But what about  
*measuring*  
productivity?

*Measuring* developer productivity  
may be *counterproductive!*



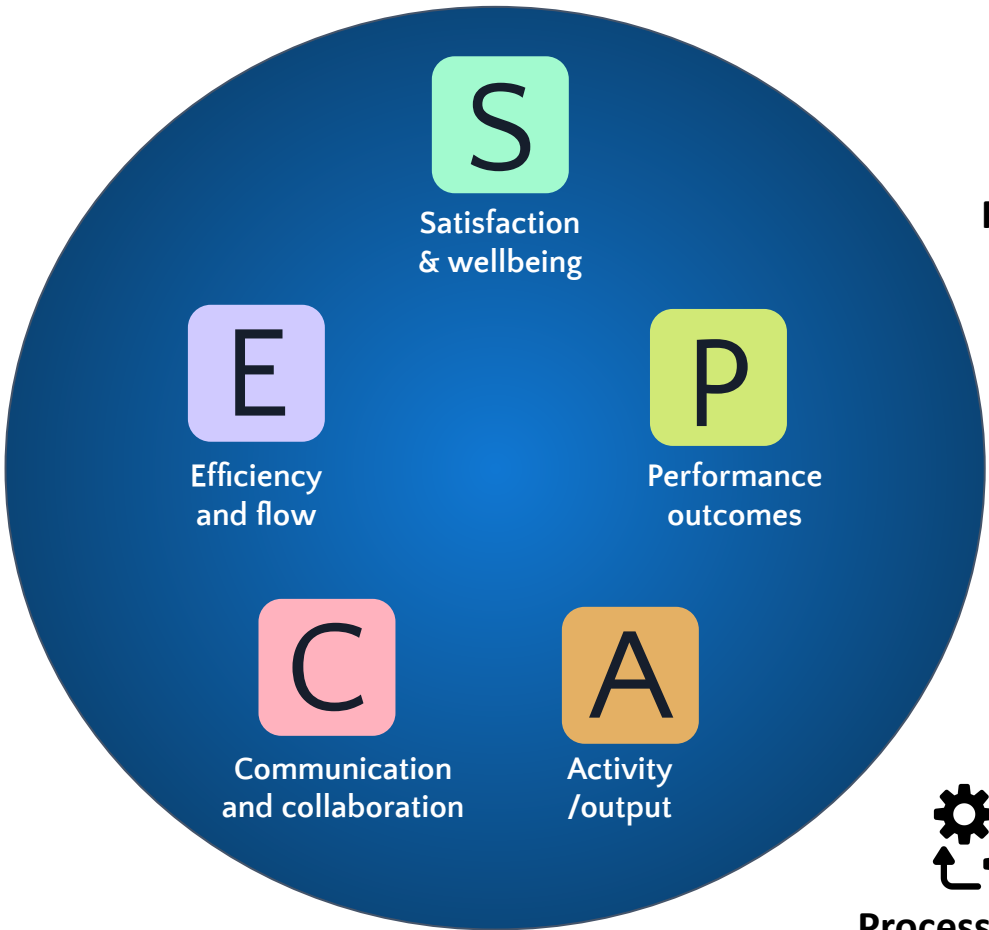
**Shreyas Doshi**  @shreyas · Mar 23

A tragedy of many modern product teams is that they have been conditioned to feel smartest when debating metrics, reviewing charts, discussing complex analyses, and not feel smart or safe when broaching the topic of customer psychology, creative solutions, and cognitive biases.

*Focus on goals  
before metrics!*



**Developer Experience**



Satisfaction  
& wellbeing



Efficiency  
and flow



Performance  
outcomes



Communication  
and collaboration



Activity  
/output

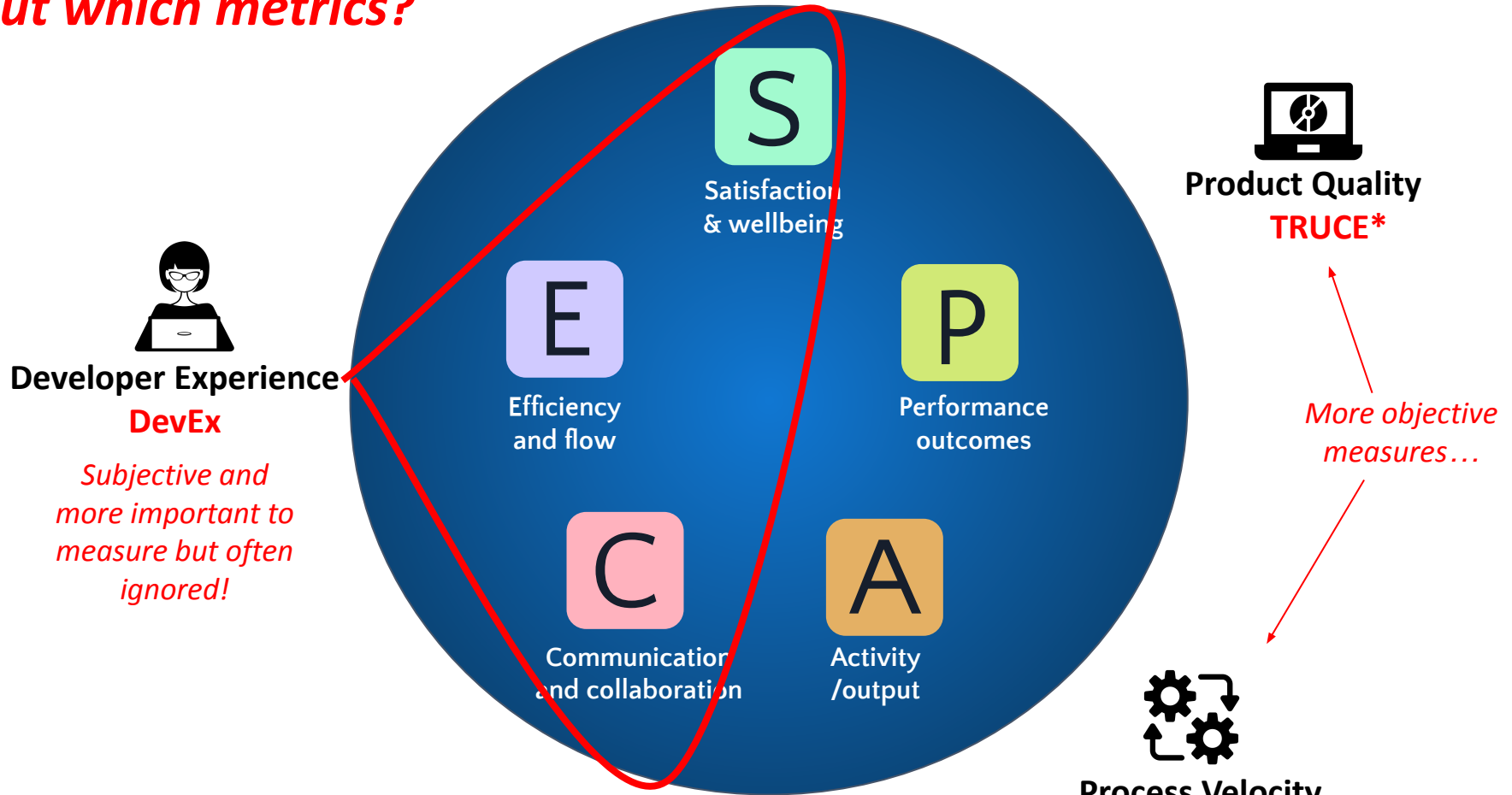


**Product Quality**



**Process Velocity**

# But which metrics?



\*Storey, Houck, Zimmermann: How Developers and Managers Define and Trade Productivity for Quality. CHASE 2022

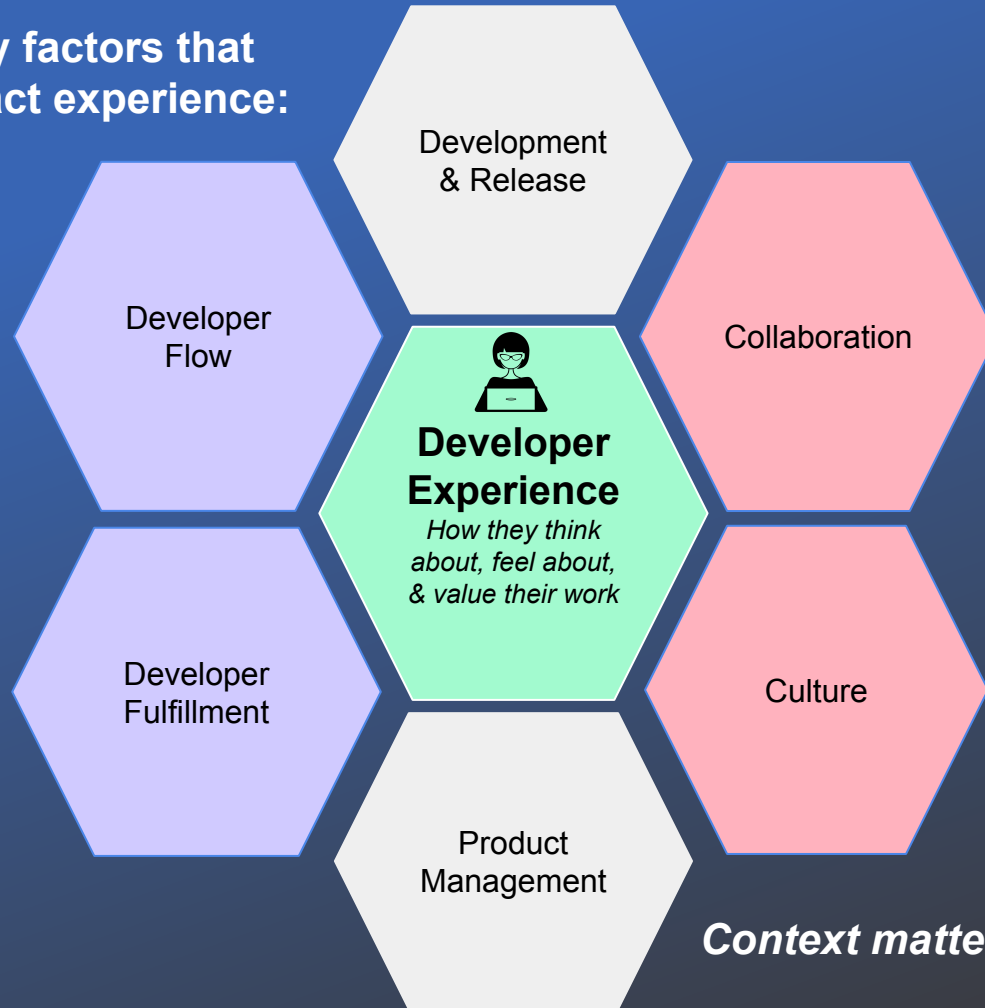


## **Developer Experience**

*How devs **think about,**  
**feel about,** and  
**value their work***

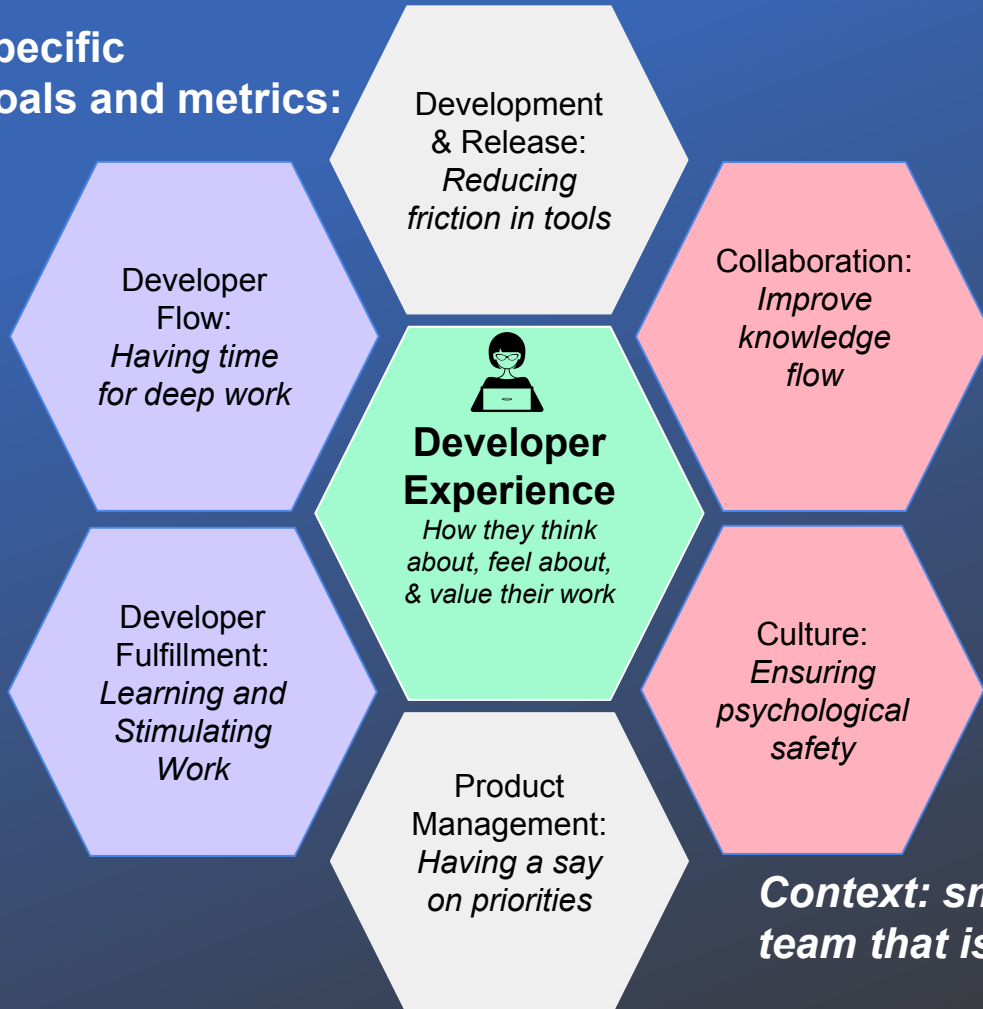


**6 key factors that  
impact experience:**



***Context matters....***

**Factors drive specific improvement goals and metrics:**

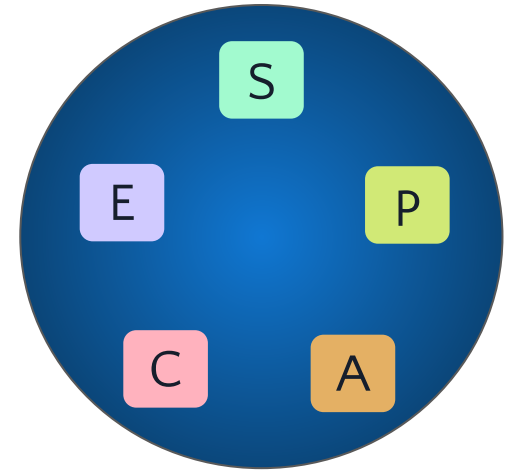


**Context: small startup team that is remote**

# Takeaways!

Productivity means different things to different people, it is **more complicated** than we think

There are **no universal productivity metrics** – specific **goals** needed to drive **context** specific metrics



Understanding & improving **developer experience** holds the key to productivity



*“Being **empowered** to do my best work, joyfully.”*

# Research references and links

Margaret-Anne Storey, Brian Houck, Tom Zimmermann: **How Developers and Managers Define and Trade Productivity for Quality**. CHASE (International Conference on Cooperative and Human Aspects in Software Engineering, 2022). [PDF](#)

Margaret-Anne Storey, Tom Zimmermann, Chris Bird, Jacek Czerwonka, Brendan Murphy, Eirini Kalliamvakou: **Towards a Theory of Software Developer Job Satisfaction and Perceived Productivity**. IEEE Trans. Software Eng. 47(10): 2125-2142 (2021) [PDF](#)

Nicole Forsgren, Margaret-Anne Storey, Chandra Maddila, Tom Zimmermann, Brian Houck, Jenna Butler: **The SPACE of Developer Productivity**. Commun. ACM 64(6): 46-53 (2021) [PDF](#)

Denae Ford, Margaret-Anne Storey, Tom Zimmermann, Christian Bird, Sonia Jaffe, Chandra Shekhar Maddila, Jenna Butler, Brian Houck, Nachiappan Nagappan: **A Tale of Two Cities: Software Developers Working from Home During the COVID-19 Pandemic**. ACM Transactions on Software Engineering and Methodology (TOSEM), 2021. [PDF](#)

Courtney Miller, Paige Rodeghero, Margaret-Anne Storey, Denae Ford, Tom Zimmermann: **"How Was Your Weekend?" Software Development Teams Working From Home During COVID-19**. ICSE 2021: 624-636. [PDF](#)

Margaret-Anne Storey: **After the pandemic, Rethinking Developer Productivity**, Keynote Talk at ICGSE and ISSP 2021. [Link](#)

Caitlin Sadowski, Margaret-Anne Storey, Robert Feldt: **A Software Development Productivity Framework**. Rethinking Productivity in Software Engineering 2019: 39-47 [PDF](#)

Margaret-Anne Storey, Christoph Treude: **Software Engineering Dashboards: Types, Risks, and Future**. Rethinking Productivity in Software Engineering 2019: 179-190 [PDF](#)

Michaela Greiler, Margaret-Anne Storey, Abi Noda: **An Actionable Framework for Understanding and Improving Developer Experience**, To Appear in IEEE Transactions on Software Engineering 2022. [PDF](#)

# Selected related work

Flow and efficiency in software development, by Arty Starr <https://leanpub.com/ideaflow>, <https://www.flowinsight.com/>

Interruptions in software development and other aspects of developer productivity, by Andre Meyer & Tom Zimmermann: <https://andre-meyer.ch/research/> and <https://www.microsoft.com/en-us/research/people/tzimmer/>

Happiness and the productivity of software engineers, D Graziotin, F Fagerholm, Rethinking Productivity in Software Engineering, 109-124 [PDF](#)

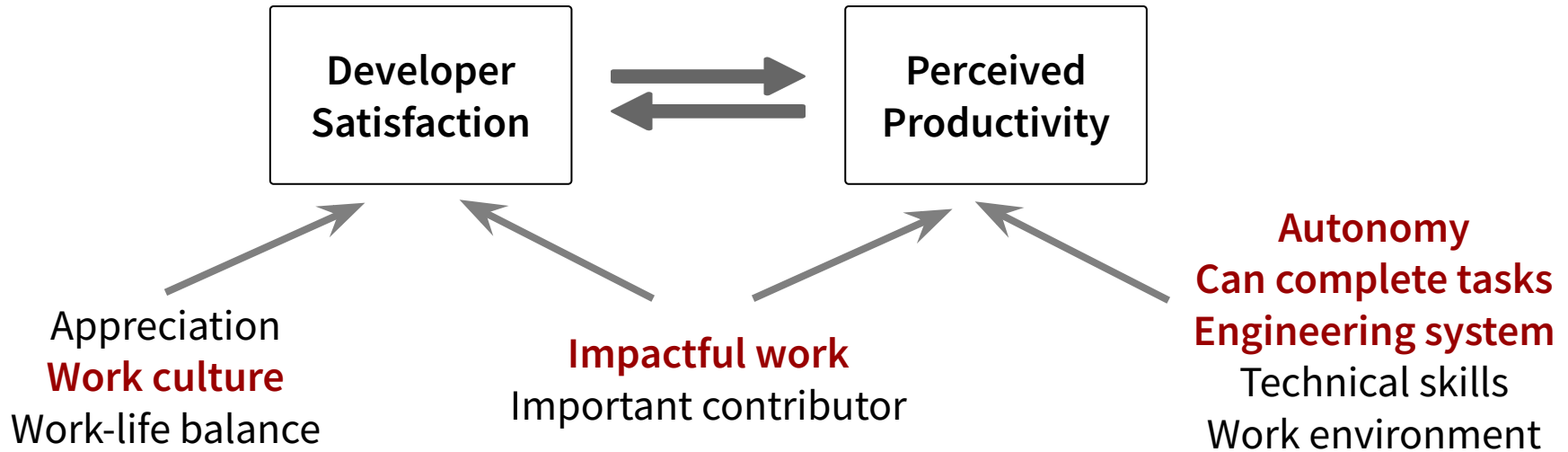
Developer experience: Concept and definition by F Fagerholm, J Munch  
Software and System Process (ICSSP), 2012 International Conference on, 73-77.

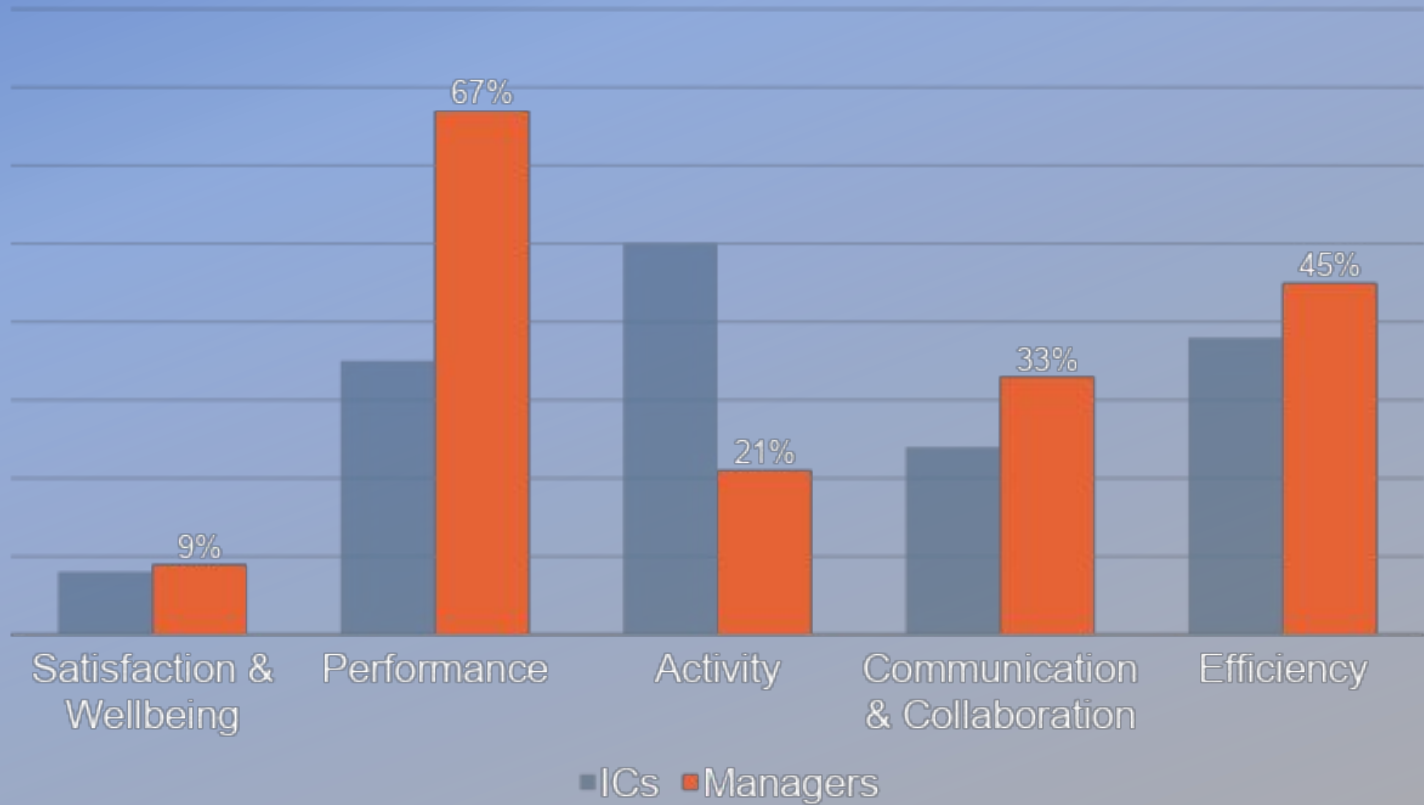
A Systematic Review of Productivity Factors in Software Development by  
Stefan Wagner, Melanie Ruhe, <https://arxiv.org/abs/1801.06475>



Extra slides  
(cut to save time!)

# Developer satisfaction and productivity **theory**





***Misaligned views and productivity tradeoffs!***

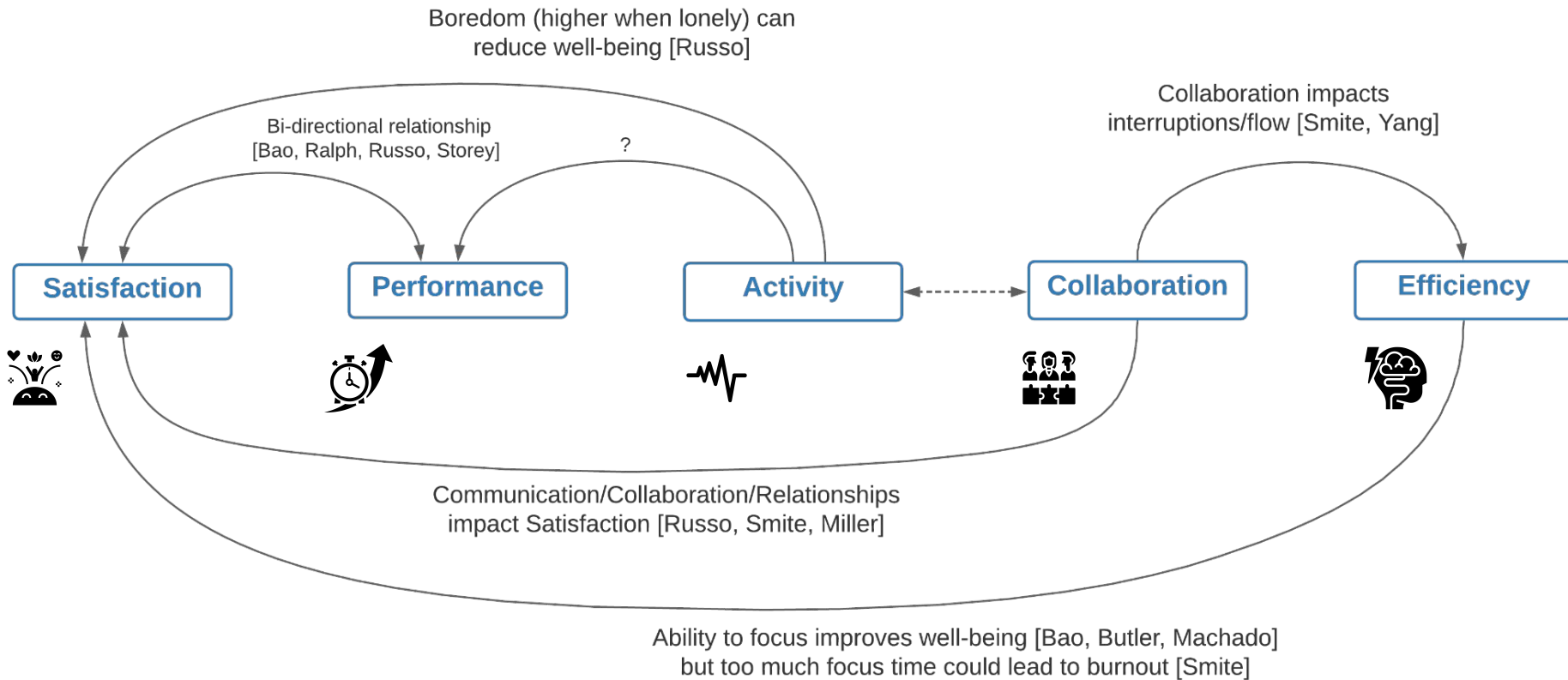
Forsgren, Storey, Maddila,  
Zimmermann, Houck, Butler,  
**The SPACE of developer  
productivity.** Commun. ACM 2021

*Possible metrics.... By level but still  
need to choose which ones...*

FIGURE 1: EXAMPLE METRICS

LEVEL	SATISFACTION & WELL-BEING How fulfilled, happy, and healthy one is	PERFORMANCE An outcome of a process	ACTIVITY The count of actions or outputs	COMMUNICATION & COLLABORATION How people talk and work together	EFFICIENCY & FLOW Doing work with minimal delays or interruptions
<b>INDIVIDUAL</b> One person	<ul style="list-style-type: none"> <li>* Developer satisfaction</li> <li>* Retention<sup>†</sup></li> <li>* Satisfaction with code reviews assigned</li> <li>* Perception of code reviews</li> </ul>	<ul style="list-style-type: none"> <li>* Code review velocity</li> </ul>	<ul style="list-style-type: none"> <li>* Number of code reviews completed</li> <li>* Coding time</li> <li>* # Commits</li> <li>* Lines of code<sup>†</sup></li> </ul>	<ul style="list-style-type: none"> <li>* Code review score (quality or thoughtfulness)</li> <li>* PR merge times</li> <li>* Quality of meetings<sup>†</sup></li> <li>* Knowledge sharing, discoverability (quality of documentation)</li> </ul>	<ul style="list-style-type: none"> <li>* Code review timing</li> <li>* Productivity perception</li> <li>* Lack of interruptions</li> </ul>
<b>TEAM OR GROUP</b> People that work together	<ul style="list-style-type: none"> <li>* Developer satisfaction</li> <li>* Retention<sup>†</sup></li> </ul>	<ul style="list-style-type: none"> <li>* Code review velocity</li> <li>* Story points shipped<sup>†</sup></li> </ul>	<ul style="list-style-type: none"> <li>* # Story points completed<sup>†</sup></li> </ul>	<ul style="list-style-type: none"> <li>* PR merge times</li> <li>* Quality of meetings<sup>†</sup></li> <li>* Knowledge sharing or discoverability (quality of documentation)</li> </ul>	<ul style="list-style-type: none"> <li>* Code review timing</li> <li>* Handoffs</li> </ul>
<b>SYSTEM</b> End-to-end work through a system (like a development pipeline)	<ul style="list-style-type: none"> <li>* Satisfaction with engineering system (e.g., CI/CD pipeline)</li> </ul>	<ul style="list-style-type: none"> <li>* Code review velocity</li> <li>* Code review (acceptance rate)</li> <li>* Customer satisfaction</li> <li>* Reliability (uptime)</li> </ul>	<ul style="list-style-type: none"> <li>* Frequency of deployments</li> </ul>	<ul style="list-style-type: none"> <li>* Knowledge sharing, discoverability (quality of documentation)</li> </ul>	<ul style="list-style-type: none"> <li>* Code review timing</li> <li>* Velocity/flow through the system</li> </ul>

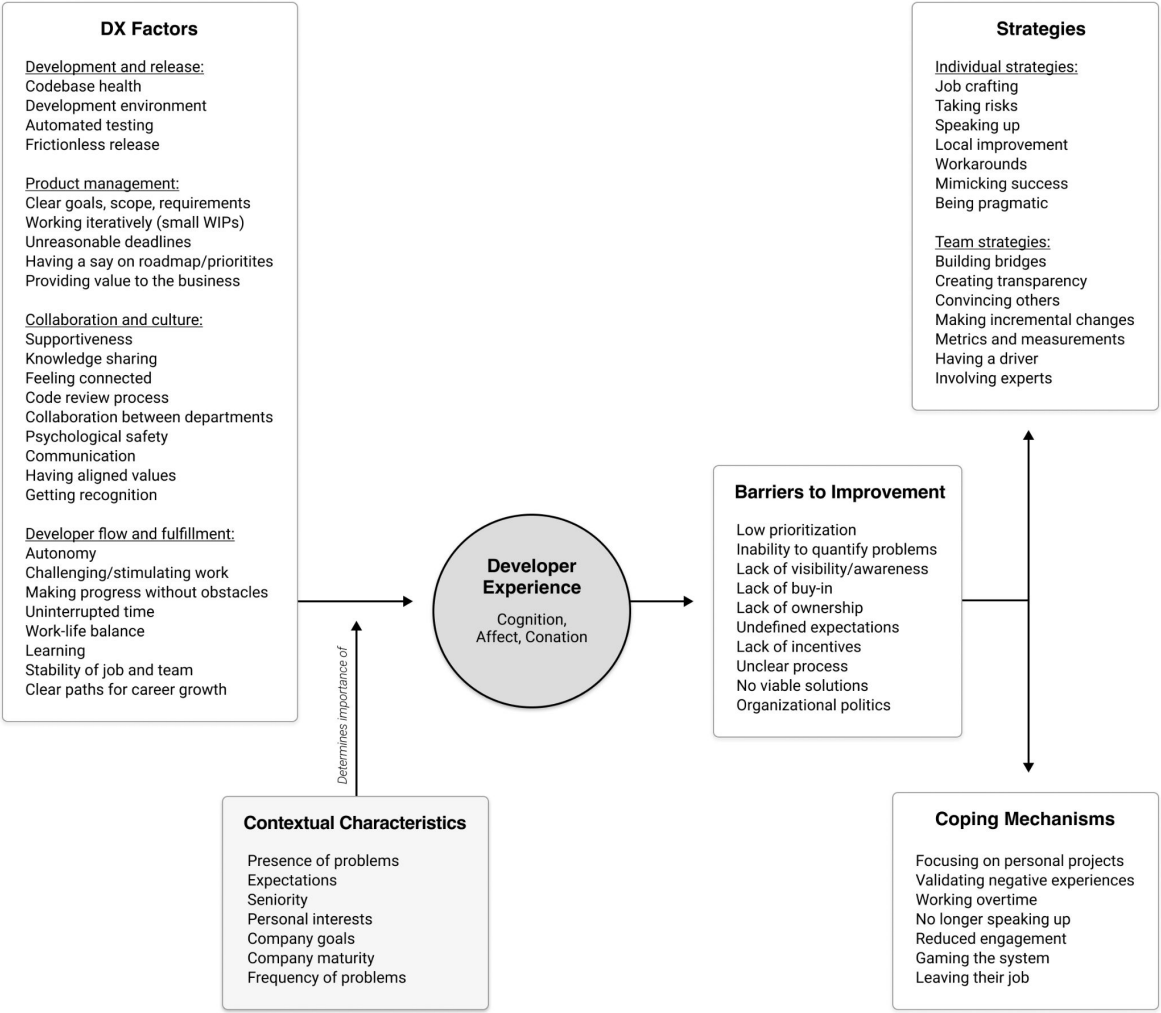
# The dimensions of productivity are not independent!





Michaela Greiler, Margaret-Anne Storey, Abi Noda: **An Actionable Framework for Understanding and Improving Developer Experience**, To Appear TSE 2022.

The factors in more detail, the paper also discusses importance of context for moderating the impact of those factors, as well as barriers to improving experience, individual and team strategies for improving experience, and coping mechanisms if improvements can't be made:



**DX Factors**

Development and release:  
 Codebase health  
 Development environment  
 Automated testing  
 Frictionless release

Product management:  
 Clear goals, scope, requirements  
 Working iteratively (small WIPs)  
 Unreasonable deadlines  
 Having a say on roadmap/priorities  
 Providing value to the business

Collaboration and culture:  
 Supportiveness  
 Knowledge sharing  
 Feeling connected  
 Code review process  
 Collaboration between departments  
 Psychological safety  
 Communication  
 Having aligned values  
 Getting recognition

Developer flow and fulfillment:  
 Autonomy  
 Challenging/stimulating work  
 Making progress without obstacles  
 Uninterrupted time  
 Work-life balance  
 Learning  
 Stability of job and team  
 Clear paths for career growth

**Contextual Characteristics**

- Presence of problems
- Expectations
- Seniority
- Personal interests
- Company goals
- Company maturity
- Frequency of problems

**Developer Experience**  
 Cognition, Affect, Conation

**Barriers to Improvement**

- Low prioritization
- Inability to quantify problems
- Lack of visibility/awareness
- Lack of buy-in
- Lack of ownership
- Undefined expectations
- Lack of incentives
- Unclear process
- No viable solutions
- Organizational politics

**Coping Mechanisms**

- Focusing on personal projects
- Validating negative experiences
- Working overtime
- No longer speaking up
- Reduced engagement
- Gaming the system
- Leaving their job

**Strategies**

Individual strategies:  
 Job crafting  
 Taking risks  
 Speaking up  
 Local improvement  
 Workarounds  
 Mimicking success  
 Being pragmatic

Team strategies:  
 Building bridges  
 Creating transparency  
 Convincing others  
 Making incremental changes  
 Metrics and measurements  
 Having a driver  
 Involving experts