

Connecting Mental Health and Productivity: A Metric Catalog for Software Development Teams

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Abstract

Software developer productivity is shaped by technical, organizational, and individual factors, with mental health playing an important role in sustainable performance. This study investigates developers' perceptions of metrics that jointly capture productivity and mental health. We first conducted a systematic mapping study that identified 99 factors associated with productivity and/or mental health. Based on these findings, we developed a catalog of 12 metrics. The catalog was evaluated through a mixed-methods study involving 47 software developers. The results indicate a broad recognition of the relevance and potential usefulness of the proposed metrics, while also revealing concerns about privacy, autonomy, surveillance, and their use for individual performance evaluation. In addition, the study provides an evidence-informed foundation for future empirical validation of the proposed metrics and for their responsible adoption in software organizations.

Keywords

Software development, Mental health, Productivity, Metrics

1 Introduction

Software development is a knowledge-intensive activity in which productivity depends on the continuous interaction of technical, organizational, social, and individual factors. Traditional approaches to measuring developer productivity have predominantly emphasized observable outputs, such as commits, completed tasks, or resolved issues. However, these measures provide only a partial view of developer performance and may not capture important dimensions of work quality, collaboration, and individual well-being [3, 7, 9, 11]. At the same time, empirical studies have shown that the mental health and emotional states of developers are closely related to their productivity, motivation, and work engagement [6]. In particular, software engineering research has increasingly recognized that stress, workload, organizational conditions, and interpersonal relationships can influence both individual well-being and software development outcomes [5, 8, 10]. Consequently, there is a growing need for measurement approaches that consider productivity and mental health jointly rather than as independent concerns.

Despite increasing interest in this relationship, there remains a lack of systematic guidance on which metrics can be used to capture the multiple dimensions of developer mental health and productivity and how these metrics should be interpreted in software development contexts. Existing productivity measures, such as lines of code or commit counts, can provide useful information about development activity but are insufficient to capture the complexity and quality of developers' work or the mental strain associated with it [3, 9, 11]. Similarly, workplace well-being measures are often broad

and generic, providing limited insight into cognitive, social, and organizational conditions experienced by developers [4, 13].

To address this gap, we proposed a catalog of metrics for understanding developer mental health and productivity. Our catalog is grounded in evidence from the software engineering literature and complemented by empirical insights from industry professionals. The original paper was published in the Empirical Software Engineering (EMSE) journal [2]. We first conducted a systematic mapping study that identified 99 factors associated with productivity and/or mental health. Based on these findings, we developed a catalog comprising 12 metrics covering individual and team dimensions. The catalog combines established indicators with metrics that reinterpret or extend existing constructs through a mental health-aware perspective, with the goal of integrating their measurement into everyday software development workflows. The proposed metrics were subsequently assessed through a mixed-methods study involving 47 software developers in a survey, with 22 participants also taking part in structured interviews. The results provide insights into the perceived relevance, applicability, and acceptance of the proposed metrics while highlighting important concerns regarding their use as evaluative mechanisms.

This work provides an evidence-informed foundation for responsible measurement and establishes a basis for future longitudinal studies investigating the hypothesized relationships among developer well-being, team dynamics, and sustainable productivity.

The study contributions are: (i) a structured catalog of 12 mental health and productivity metrics, (ii) a replicable framework for validating this and other catalogs, (iii) empirical evidence from 47 developers, (iv) evidence regarding the acceptance, limitations, and ethical concerns associated with these metrics, and (v) practical guidance for their responsible use.

2 Proposed Catalog and Study Design

The proposed catalog provides a structured set of metrics intended to capture complementary dimensions of mental health and productivity in software development teams. The catalog combines individual- and team-level indicators and considers both psychological and behavioral aspects. To assess the perceived relevance and applicability of the catalog, we designed a mixed-methods empirical study combining survey with interviews. First, the study protocol and measurement instruments were prepared and refined through a pilot phase involving software engineering professionals. Second, 47 developers evaluated each metric and its proposed measurement strategy through the survey, providing structured assessments of their perceived relevance, applicability, and acceptance. Subsequently, a subset of 22 participants took part in structured interviews, where they could elaborate on their perceptions, discuss potential benefits and concerns, and suggest improvements or

alternative ways of operationalizing the metrics. This sequential protocol also allowed us to examine how developers interpret the metrics when presented with concrete definitions and measurement strategies. The quantitative and qualitative evidence collected was subsequently analyzed to identify common patterns, disagreements, and practical considerations for the adoption of the catalog.

To further articulate how these metrics may connect, we developed a conceptual causal diagram that organizes all metrics into interconnected psychological, social and environmental, and productivity/resource layers. The diagram makes explicit the hypothesized direction of influence among metrics and highlights potential positive and negative feedback loops through which mental health and productivity may reinforce or undermine one another over time. These relationships remain hypotheses to be empirically validated through future organizational and longitudinal studies.

3 Results

The results provide evidence that developers perceive mental health and productivity as closely interconnected, multidimensional constructs. While participants' definitions broadly aligned with established definitions, particularly the WHO perspective on mental well-being [12], they also emphasized resilience, personal history and past experiences, external circumstances, and the interdependence between mental and physical health. Similarly, productivity was not perceived solely in terms of quantity or output. Participants highlighted the importance of quality, expectations, deadlines, available resources, workplace conditions, and organizational support. These findings reinforce the need for a holistic measurement approach that considers both individual and contextual factors rather than relying exclusively on traditional productivity indicators.

All proposed metrics were mentioned by at least one participant as either positively or negatively relevant, suggesting that the catalog captures dimensions that developers recognize as meaningful. Metrics such as Work Capacity, Work Vision, Work Environmental Conditions, and Motivation received particularly favorable perceptions, whereas traditional activity-oriented measures such as Number of Commits were criticized for potentially providing an incomplete representation of productivity. The findings also revealed that acceptance depends strongly on how metrics are measured and interpreted. In particular, Quality of Social Interactions raised substantial concerns regarding privacy, behavioral changes caused by surveillance, and the ability of AI techniques to correctly interpret contextual aspects such as humor, sarcasm, and emotional nuance.

Overall, participants considered the catalog potentially useful for helping managers identify patterns and initiate conversations, while emphasizing that it should remain flexible and context-sensitive. Organizations should select metrics according to their teams, objectives, and organizational contexts rather than applying the entire catalog indiscriminately. These findings establish a foundation for the next stage of research, involving real-world deployment, longitudinal validation, and empirical testing of the hypothesized relationships among the metrics.

4 Conclusion and Future Work

The results of this study were published at the Empirical Software Engineering (EMSE) journal [2]. This study investigated the connection between mental health and productivity in software

development and proposed a catalog of twelve metrics designed to capture complementary psychological, social, environmental, and productivity-related dimensions. The catalog was developed from evidence identified in the literature and subsequently evaluated through a mixed-method study involving 47 software developers. The results indicate that developers generally recognize the relevance and potential usefulness of the proposed metrics, while also reinforcing the need to use such metrics as contextual and reflective indicators rather than as proxies for individual performance.

We are currently finalizing the implementation of a mobile app that integrates all metrics from the catalog. As a next step, the catalog will be evaluated through longitudinal deployments in real-world software development organizations to assess its feasibility, reliability, and practical value. Through industrial case studies, we will also examine the directional relationships proposed in the conceptual model, investigating how psychological, social, environmental, behavioral, and productivity indicators interact and evolve across software development cycles.

Artifact Availability

All available data are currently available at [1].

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