



## EFFECTS OF WORK PROCESS DIGITALIZATION, TECHNOLOGICAL CAPABILITY, AND COMPETENCE ON PRODUCTIVITY THROUGH WORK EFFICIENCY AT BATAM CUSTOMS AND EXCISE

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### Abstract

This study aims to analyze the effects of work process digitalization, technological capability, and employee competence on employee productivity at the Batam Type B Main Customs and Excise Office, both directly and indirectly through work efficiency as an intervening variable. Batam's Free Trade Zone (FTZ) environment requires fast, accurate, and transparent customs service workflows. This quantitative study employed an explanatory design using Partial Least Squares Structural Equation Modeling (PLS-SEM). The population comprised 445 employees, and a sample of 211 respondents was determined using the Slovin formula and probability sampling. Primary data were collected through Likert-scale questionnaires and analyzed using SmartPLS. The findings indicate that work process digitalization, technological capability, and competence have positive and significant effects on both work efficiency and employee productivity. Work efficiency also significantly mediates the effects of the three independent variables on employee productivity. These findings emphasize that customs automation systems, such as CEISA 4.0 and SSMQC, should be accompanied by continuous technological capacity development to optimize public-sector operational productivity.

**Keywords:** Competence; Employee Productivity; Technological Capability; Work Efficiency; Work Process Digitalization

### INTRODUCTION

Advances in information technology have encouraged public-sector organizations to undertake digital transformation in order to improve service quality and work effectiveness. The Directorate General of Customs and Excise, as an institution responsible for customs services and supervision, faces increasing demands to carry out work processes quickly, accurately, and efficiently. These demands are particularly relevant to the Batam Type B Main Customs and Excise Office because Batam is a free trade zone with intensive and dynamic logistics activities.

Work process digitalization enables various manual activities to be transferred to technology-based systems. The use of information systems, service automation, data integration, and internal applications is expected to reduce bureaucratic bottlenecks, accelerate task completion, reduce repetitive work, and minimize errors arising from manual processes. In practice, however, the success of digitalization is not determined solely by the availability of technology. Employees' ability to use technology is also important because digital systems can provide optimal benefits only when they are used effectively. Employee competence, including knowledge, skills, abilities, and attitudes, is likewise an important component of effective work execution.

The study shows that the Batam Type B Main Customs and Excise Office has implemented several digital technologies, including CEISA 4.0, ION Beta, SSMQC, Biola, Frontdesk Online, Redress Manifes Online, and integrated logistics systems. These systems are intended to accelerate service delivery, improve data accuracy, reduce manual work, and increase work efficiency. Nevertheless, employee productivity still varies. Some employees experience difficulties adapting to new digital systems, while others have not yet used the available technology optimally. These conditions demonstrate the importance of examining the relationships among work process digitalization, technological capability, competence, work efficiency, and employee productivity.

## LITERATURE REVIEW

### Work Process Digitalization

Work process digitalization refers to the application of digital technology to improve internal efficiency, reduce administrative burdens, and accelerate service interactions within organizations (OECD, 2019). Davenport (2018) describes work process digitalization as the transformation of manual activities into digital systems with the aim of improving information integration, accelerating decision-making, and minimizing obstacles in organizational workflows.

### Technological Capability

Technological capability is the ability to acquire, harmonize, and improve knowledge and capabilities that enable an organization to develop sustainable innovative capacity and achieve better business outcomes (Skare & Soriano, 2021). At the individual level, technological capability refers to the capacity to understand, operate, use, develop, and utilize technology to support work activities. It includes knowledge and skills related to the devices, information systems, and applications used by the organization. Employees with strong technological capability tend to use digital systems more optimally, complete tasks more quickly, reduce system-use errors, and adapt more effectively to technological change.

### Competence

Vitello and Greatorox (2022) define competence as the ability to integrate and apply knowledge, skills, and psychosocial factors, such as attitudes, values, and motivation, appropriately in a given context in order to demonstrate consistent and successful performance within a particular domain. Competence also represents an underlying individual characteristic that supports effective performance and reflects the abilities possessed by an individual (Eliana, 2019).

### Work Efficiency

Hasibuan (2021) defines work efficiency as the optimal use of resources to achieve maximum work results with minimum cost and time. Fahmi (2021) explains efficiency as a performance measure that considers whether work is completed within the planned time, with stronger efficiency reflected in more intensive resource savings. Mulyana Rahmat (2024, p. 2) states that, from a macro perspective, efficiency supports economic system stability because efficient organizations can contribute to price stability and the smooth operation of cross-sector activities. At the micro level, efficiency reflects an institution's or work unit's ability to manage inputs and outputs optimally. An efficient entity tends to produce better work results, provide faster services, and manage operational costs more competitively.

### Employee Productivity

Employee productivity refers to an employee's ability to generate optimal outputs from available resources. Productivity can be assessed through ability, work achievement, work spirit, self-development, quality, and efficiency. Hasibuan (2016) explains productivity as the ratio between outputs and inputs. Increased productivity improves the efficiency of time, materials, and labor, as well as work systems, production techniques, and employee skills. Productivity is particularly important in public organizations because it reflects employees' ability to achieve work targets effectively and efficiently.

### Research Model and Hypotheses

The research model positions work process digitalization (X1), technological capability (X2), and competence (X3) as independent variables. Work efficiency (Z) functions as an intervening variable, while employee productivity (Y) is the dependent variable. The hypotheses are formulated as follows:

| Hypothesis | Statement                                                  |
|------------|------------------------------------------------------------|
| H1         | Work process digitalization affects employee productivity. |
| H2         | Technological capability affects employee productivity.    |
| H3         | Competence affects employee productivity.                  |

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| Hypothesis | Statement                                                                          |
|------------|------------------------------------------------------------------------------------|
| H4         | Work efficiency affects employee productivity.                                     |
| H5         | Work process digitalization affects work efficiency.                               |
| H6         | Technological capability affects work efficiency.                                  |
| H7         | Competence affects work efficiency.                                                |
| H8         | Work process digitalization affects employee productivity through work efficiency. |
| H9         | Technological capability affects employee productivity through work efficiency.    |
| H10        | Competence affects employee productivity through work efficiency.                  |

## METHOD

This study used a quantitative approach and was conducted at the Batam Type B Main Customs and Excise Office, Jalan Kuda Laut, Batu Ampar, Batam. The research period lasted six months, from November 2025 to April 2026. The population consisted of 445 employees of the Batam Customs and Excise Office. The sample was determined using the Slovin technique, resulting in 211 respondents. The study used both primary and secondary data. Primary data were obtained through questionnaires, while secondary data were obtained from organizational documentation. The research instrument was evaluated through validity and reliability tests. Data were collected through questionnaires and documentation. Relationships among variables were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with a bootstrapping procedure. Hypotheses were tested at a 5 percent significance level. A relationship was considered significant when the T-statistic exceeded 1.96 and the P-value was below 0.05.

## RESULTS AND DISCUSSION

### Measurement Model Analysis (Outer Model)

The measurement model was evaluated using indicator outer loadings, convergent validity, construct reliability, discriminant validity, and model-fit indices. The outer-loading results are summarized in Table 1.

**Table 1.** Outer Loadings

| Work Process Digitalization (X1) | Technological Capability (X2) | Competence (X3) | Work Efficiency (Z) | Employee Productivity (Y) |
|----------------------------------|-------------------------------|-----------------|---------------------|---------------------------|
| X1.1 = 0.752                     | X2.1 = 0.764                  | X3.1 = 0.753    | Z1.1 = 0.780        | Y1.1 = 0.731              |
| X1.2 = 0.851                     | X2.2 = 0.749                  | X3.2 = 0.812    | Z1.2 = 0.707        | Y1.2 = 0.768              |
| X1.3 = 0.846                     | X2.3 = 0.853                  | X3.3 = 0.783    | Z1.3 = 0.703        | Y1.3 = 0.827              |
| X1.4 = 0.673                     | X2.4 = 0.805                  | X3.4 = 0.864    | Z1.4 = 0.672        | Y1.4 = 0.765              |
| X1.5 = 0.810                     | X2.5 = 0.787                  | X3.5 = 0.809    | Z1.5 = 0.685        | Y1.5 = 0.769              |
| X1.6 = 0.752                     | X2.6 = 0.710                  | X3.6 = 0.654    | Z1.6 = 0.705        | Y1.6 = 0.712              |
| X1.7 = 0.824                     | X2.7 = 0.866                  | X3.7 = 0.755    | Z1.7 = 0.705        | Y1.7 = 0.766              |
| X1.8 = 0.775                     | X2.8 = 0.718                  | X3.8 = 0.789    | Z1.8 = 0.694        | Y1.8 = 0.753              |
| X1.9 = 0.727                     | X2.9 = 0.691                  | X3.9 = 0.735    | Z1.9 = 0.820        | Y1.9 = 0.769              |
| X1.10 = 0.870                    | X2.10 = 0.792                 | X3.10 = 0.818   | Z1.10 = 0.872       | Y1.10 = 0.783             |
| X1.11 = 0.840                    | X2.11 = 0.797                 | X3.11 = 0.880   | Z1.11 = 0.827       | Y1.11 = 0.739             |
| X1.12 = 0.699                    | X2.12 = 0.865                 | X3.12 = 0.885   | Z1.12 = 0.677       | Y1.12 = 0.816             |
|                                  | X2.13 = 0.946                 |                 | Z1.13 = 0.707       | Y1.13 = 0.756             |

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| Work Process Digitalization (X1) | Technological Capability (X2) | Competence (X3) | Work Efficiency (Z) | Employee Productivity (Y) |
|----------------------------------|-------------------------------|-----------------|---------------------|---------------------------|
|                                  | X2.14 = 0.865                 |                 | Z1.14 = 0.701       | Y1.14 = 0.766             |
|                                  | X2.15 = 0.846                 |                 | Z1.15 = 0.713       | Y1.15 = 0.763             |
|                                  | X2.16 = 0.869                 |                 |                     | Y1.16 = 0.800             |
|                                  | X2.17 = 0.868                 |                 |                     | Y1.17 = 0.793             |
|                                  | X2.18 = 0.761                 |                 |                     | Y1.18 = 0.761             |

Source: Primary data processed, 2026.

Convergent validity results show that all final indicators have outer-loading values above 0.60, with the highest loading reaching 0.946, and Average Variance Extracted (AVE) values above 0.50. Indicators that did not meet the elimination criterion, namely X1.4, X1.12, X2.9, X3.6, Z1.4, Z1.5, Z1.8, and Z1.12, were removed from the model before structural analysis. Construct reliability was supported by Cronbach's Alpha, rho\_A, and Composite Reliability values for all variables (X1, X2, X3, Z, and Y), which ranged from 0.70 to 0.95, indicating very good internal consistency of the instrument.

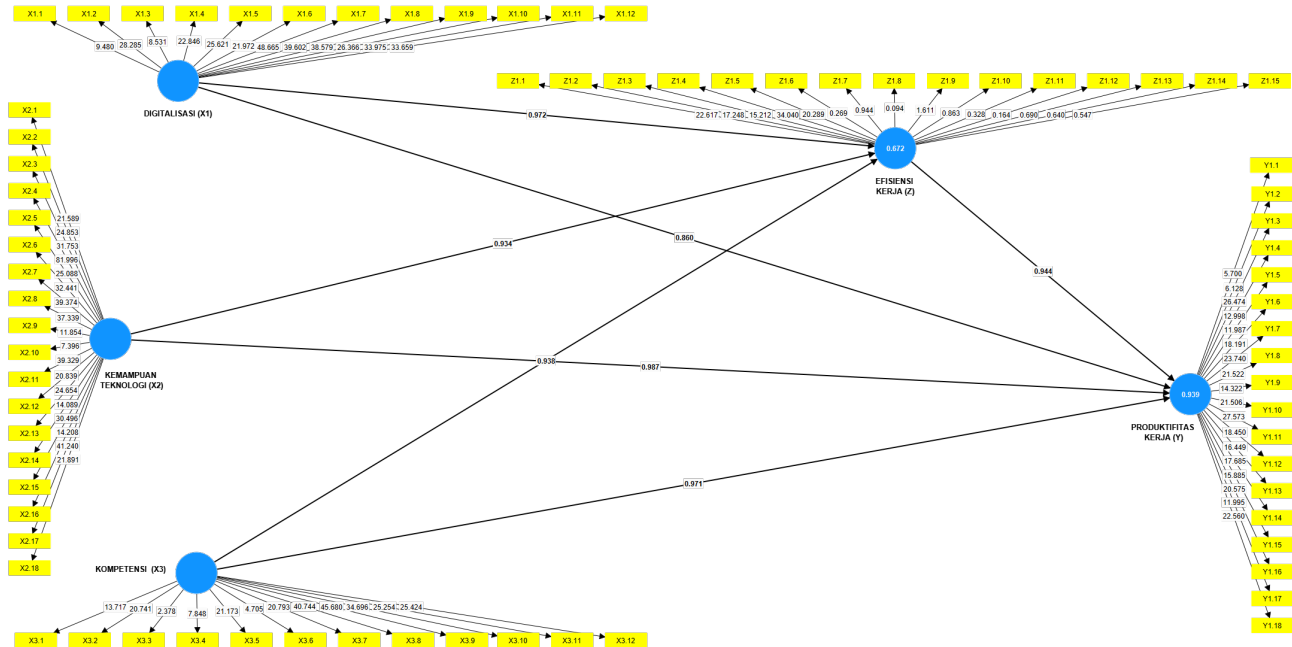


Figure 1. Structural Path Model

Source: Primary data processed, 2026.

Table 2. Heterotrait-Monotrait Ratio (HTMT) Analysis

|                               | Digitalization (X1) | Work Efficiency (Z) | Technological Capability (X2) | Competence (X3) | Employee Productivity (Y) |
|-------------------------------|---------------------|---------------------|-------------------------------|-----------------|---------------------------|
| Digitalization (X1)           |                     |                     |                               |                 |                           |
| Work Efficiency (Z)           | 0.534               |                     |                               |                 |                           |
| Technological Capability (X2) | 0.598               | 0.518               |                               |                 |                           |
| Competence (X3)               | 0.597               | 0.528               | 0.893                         |                 |                           |
| Employee Productivity (Y)     | 0.596               | 0.530               | 0.899                         | 0.889           |                           |

Source: Primary data processed, 2026.

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**Table 3.** Model Fit

|            | Saturated model | Estimated model |
|------------|-----------------|-----------------|
| SRMR       | 0.107           | 0.107           |
| d_ ULS     | 32.727          | 32.727          |
| d_ G       | 59.213          | 59.213          |
| Chi-square | 25688.727       | 25688.727       |
| NFI        | 0.310           | 0.310           |

Source: Primary data processed, 2026.

## Direct Effects

**Table 4.** Direct Effects

|                                                            | Original sample (O) | Sample mean (M) | Standard deviation (STDEV) | T statistics ( O/STDEV ) | P values | Decision        |
|------------------------------------------------------------|---------------------|-----------------|----------------------------|--------------------------|----------|-----------------|
| Digitalization (X1) -> Employee Productivity (Y)           | 0.493               | 0.491           | 0.067                      | 7.396                    | 0.000    | Significant     |
| Technological Capability (X2) -> Employee Productivity (Y) | 0.388               | 0.390           | 0.063                      | 6.128                    | 0.000    | Significant     |
| Competence (X3) -> Employee Productivity (Y)               | 0.052               | 0.051           | 0.009                      | 5.565                    | 0.000    | Significant     |
| Work Efficiency (Z) -> Employee Productivity (Y)           | 0.346               | 0.348           | 0.074                      | 4.705                    | 0.000    | Significant     |
| Digitalization (X1) -> Work Efficiency (Z)                 | 0.310               | 0.311           | 0.054                      | 5.700                    | 0.000    | Significant     |
| Technological Capability (X2) -> Work Efficiency (Z)       | 0.524               | 0.524           | 0.061                      | 8.531                    | 0.000    | Significant     |
| Competence (X3) -> Work Efficiency (Z)                     | -6.681              | 0.586           | 86.424                     | 0.077                    | 0.938    | Not Significant |

Source: Primary data processed, 2026.

The direct-effect tests show that work process digitalization has a positive and significant effect on employee productivity, with a path coefficient of 0.493, a T-statistic of 7.396, and a P-value of 0.000. Technological capability also has a positive and significant effect on employee productivity, with a coefficient of 0.388, a T-statistic of 6.128,

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and a P-value of 0.000. Competence has a positive and significant effect on employee productivity, with a coefficient of 0.052, a T-statistic of 5.565, and a P-value of 0.000. Work efficiency has a positive and significant effect on employee productivity, with a coefficient of 0.346, a T-statistic of 4.705, and a P-value of 0.000.

Regarding work efficiency, work process digitalization has a positive and significant effect, with a coefficient of 0.310, a T-statistic of 5.700, and a P-value of 0.000. Technological capability also has a positive and significant effect, with a coefficient of 0.524, a T-statistic of 8.531, and a P-value of 0.000. In contrast, competence does not have a significant effect on work efficiency. The test produced a T-statistic of 0.077 and a P-value of 0.938.

## Indirect Effects

**Table 5.** Indirect Effects

|                                                                                   | Original Sample (O) | Sample Mean (M) | Standard Deviation (STDEV) | TStatistics ( O/STDEV ) | P Values | Decision        |
|-----------------------------------------------------------------------------------|---------------------|-----------------|----------------------------|-------------------------|----------|-----------------|
| Digitalization (X1) -> Work Efficiency (Z) -> Employee Productivity (Y)           | 0.326               | 0.323           | 0.052                      | 6.238                   | 0.000    | Significant     |
| Technological Capability (X2) -> Work Efficiency (Z) -> Employee Productivity (Y) | 0.340               | 0.339           | 0.057                      | 5.960                   | 0.000    | Significant     |
| Competence (X3) -> Work Efficiency (Z) -> Employee Productivity (Y)               | -1.621              | 0.641           | 45.604                     | 0.036                   | 0.972    | Not Significant |

Source: Primary data processed, 2026.

The indirect-effect tests show that work process digitalization has a positive and significant effect on employee productivity through work efficiency. The indirect-effect coefficient is 0.326, with a T-statistic of 6.238 and a P-value of 0.000. Technological capability also has a positive and significant effect on employee productivity through work efficiency, with an indirect-effect coefficient of 0.340, a T-statistic of 5.960, and a P-value of 0.000. Meanwhile, the indirect effect of competence on employee productivity through work efficiency is not significant. The T-statistic of 0.036 and P-value of 0.972 indicate that work efficiency does not mediate the relationship between competence and employee productivity.

## Work Process Digitalization and Employee Productivity

The results show that work process digitalization has a positive and significant effect on employee productivity. This finding indicates that the more optimally digital systems are implemented, the greater the opportunity to improve employee productivity. Digitalization can accelerate access to information, reduce repetitive administrative tasks, reduce input errors, and improve coordination across units. In the Batam Type B Main Customs and Excise Office, where service activities and information management are intensive, these benefits are important for supporting the achievement of work targets.

## Technological Capability and Employee Productivity

Technological capability has a positive and significant effect on employee productivity. This finding indicates that available technology provides greater benefits when employees have the ability to operate and use it effectively. Employees who master digital systems tend to understand procedures more quickly, access information, process

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data, and complete administrative tasks more efficiently. Therefore, improving technological capability is an important strategy for increasing employee productivity.

## Competence and Employee Productivity

Competence has a positive and significant effect on employee productivity. This means that employees' knowledge, skills, abilities, and attitudes remain important factors in achieving work results. However, the direct-effect coefficient of competence on productivity is relatively small compared with those of digitalization and technological capability. This finding indicates that, in the context of digital transformation, competence needs to be directed toward skills that are relevant to job demands and the technological systems used in the workplace.

## Work Efficiency and Employee Productivity

Work efficiency has a positive and significant effect on employee productivity. This finding confirms that the ability to complete work through the optimal use of time, labor, and other resources contributes to higher productivity. Efficiency also functions as an important mechanism for translating the benefits of technology into work outcomes. Available technology does not automatically increase productivity unless it produces work processes that are faster, more accurate, and more economical in their use of resources.

## Digitalization, Technological Capability, and Work Efficiency

Work process digitalization and technological capability both have positive and significant effects on work efficiency. Technological capability has a larger coefficient than digitalization in relation to work efficiency. This result demonstrates the importance of human-resource quality in digital transformation. Digital systems can provide facilities, but employees must be able to use them optimally so that these facilities generate time savings, fewer errors, and simplified work processes.

## Competence and Work Efficiency

Unlike its relationship with productivity, competence does not have a significant effect on work efficiency. This finding indicates that employee competence does not necessarily translate automatically into more efficient work processes. Other factors may connect competence to efficiency, including the alignment between competence and job requirements, work-system support, organizational procedures, workload, and technological capability. Competence development should therefore focus on applied skills that correspond to actual job needs.

## The Intervening Role of Work Efficiency

Work efficiency mediates the effect of work process digitalization on employee productivity, with an indirect coefficient of 0.326. Work efficiency also mediates the effect of technological capability on employee productivity, with an indirect coefficient of 0.340. These findings show that the benefits of digitalization and technological capability for productivity do not occur only through direct relationships; part of their influence is translated through more efficient work processes. In contrast, work efficiency does not mediate the effect of competence on productivity. This finding is consistent with the nonsignificant effect of competence on work efficiency. Thus, competence improvement alone is not sufficient to increase productivity through the efficiency mechanism in this research model.

## CONCLUSION

The findings show that work process digitalization, technological capability, competence, and work efficiency play different roles in improving employee productivity at the Batam Type B Main Customs and Excise Office. Work process digitalization has a positive and significant effect on both employee productivity and work efficiency. Technological capability also has a positive and significant effect on employee productivity and work efficiency. Competence has a positive and significant effect on employee productivity, but it does not significantly affect work efficiency. Work efficiency has a positive and significant effect on employee productivity. In the indirect relationships, work efficiency mediates the effects of digitalization and technological capability on employee productivity, but it does not mediate the effect of competence on employee productivity. Overall, digital transformation is more effective in improving productivity when it is supported by employees' technological capability and directed toward creating more efficient work processes.

## Recommendations

The Batam Type B Main Customs and Excise Office should continue to strengthen digitalization, not only by converting manual processes into electronic processes but also by integrating systems and work units, automating repetitive administrative tasks, and developing work-monitoring systems. Employees' technological capability should be developed continuously through training and mentoring rather than only when a new system is introduced. Training should be aligned with the technologies actually used in daily work. Competence development should also

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be directed toward practical needs based on positions, workloads, and the demands of digital transformation. Training programs should integrate substantive competence, digital skills, information processing, problem-solving, and the ability to adapt to system changes. Future studies may expand the research setting to other Customs and Excise units and consider additional variables such as motivation, management support, organizational culture, workload, and organizational readiness for change.

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