The purpose of a research protocol is to document your research question(s) and describe how you will address it. Documenting your research plan will help you articulate the necessary steps for a reproducible and replicable study. This protocol template has been designed to guide researchers through ethical and methodologic considerations in developing a research plan. It will be useful in developing research output such as theses, dissertations, presentations, and journal articles. It will help ensure that you are developing and designing an ethically sound and scientifically valid study. Additional resources are available in the [resource](https://www.research.vt.edu/sirc/hrpp/resources.html) section of the Human Research Protection Program website. The [Tips](https://www.research.vt.edu/sirc/hrpp/resources/templates.html) document provides additional details for each section along with helpful tips.

**INSTRUCTIONS:**

* Use this “TEMPLATE PROTOCOL (HRP-503a)” to prepare a study protocol outlining your research plan for research that only involves **surveys, questionnaires, focus groups, or educational tests**. Do not use for intervention, observational, or biomedical/clinical research.
* If your research involves minors, please, contact the human research protection program at [irb@vt.edu](mailto:irb@vt.edu) to discuss your research plans to ensure you are using the correct template, as there are specific federal requirements for research with minors.
* Depending on the nature of your study, some sections and subsections might not be applicable to your research. If so, simply indicate “N/A.”
* Once the IRB or HRPP approves your submission, your approved version of the protocol will be stored in the IRB Protocol Management online system.
* If your research plan changes, you might need to modify your protocol and submit an amendment. Please review our guidance on amendments for exempt research the [Exempt Guidance for Amendments in PM](https://www.research.vt.edu/sirc/hrpp/resources/guides.html) to determine if an amendment is required.
  + If an amendment is required, please submit an amendment to Protocol Management with the requested modifications. Download your current protocol from Protocol Management and indicate the changes/revisions using the track changes feature to make review of the modifications easier to follow. If you are unable to use track changes, please create a new paragraph wherever you need to make a change and indicate “Amendment: Date.” Protocol Management will store the older versions of your protocol if the IRB or HRPP need to compare them during the review.

**PROTOCOL TITLE:**

Include the full protocol title.

Software Engineering Processes in Blockchain Development

**PROTOCOL NUMBER:**

Include the number assigned in Protocol Management (verify this has been added before submitting the protocol to HRPP).

22-382

**PRINCIPAL INVESTIGATOR:**

Full Name and Degrees: Dr. Chris Brown: BS, MS, Ph.D

Department: Computer Science

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**FUNDING:**

Sponsor(s): N/A

Funded or in the proposal phase? Click here to provide a response.

Is Virginia Tech the primary awardee or the coordinating center for the funding? If not, list the primary institution: Click here to provide a response.

**VERSION NUMBER/DATE:**

Include the version number and date of this protocol. Versions should start at 1.0.

1.0

**REVISION HISTORY:**

Use this table to keep track of changes.Add more rows as needed.

| **Revision #** | **Version Date** | **Brief Summary of Changes  (i.e., the different sections)** | **Consent Change?** |
| --- | --- | --- | --- |
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# Study Summary

| **Study Title** | Software Engineering Processes in Blockchain Development |
| --- | --- |
| **Primary Objective** | Understand the behavior of blockchain developers |
| **Secondary Objective(s)** | Explore the software engineering processes and tools utilized by developers who work on blockchain technologies. |
| **Study Population** | Professional software developers |
| **Sample Size** | At least 25 |
| **Research Design** | Surve with optional interview |
| **Analytic Approach** | Mixed methods |
| **Acronyms and Definitions** | *SE: Software Engineering* |

# Objectives

* 1. Describe the purpose, specific aims, and objectives of this study.

There is no formal study on the software engineering methods followed by blockchain development projects that would reveal the facts about the concern of the research community. To provide the currently missing insight on blockchain-centric projects, we have set an objective to carry out the first formal survey to explore the software engineering practices adopted by blockchain developers.

* 1. State the hypotheses to be tested.

We hypothesize that software engineers who work on blockchain technologies adopt worse programming behaviors and have limited tools to support their work compared to traditional software engineering positions.

# Background

* 1. Summarize published (or available unpublished) literature to build a rational for the research question(s), study objectives, and research design. If none are available, include a statement that there is no available research data. This section must provide a justification for the conduct of this study based on existing knowledge and should include your research question.

Blockchain technology is a rapidly changing domain for tracking transactions on peer-to-peer networks. Prior work proposes blockchain-oriented software engineering [Porru 2017], which acknowledges the need for specialized tools and techniques specifically for the development, testing, and maintenance of blockchain technologies. Additionally, researchers have proposed adopting agile software development methodologies to design blockchain applications (Marchesi 2018). Further, Beller et al. also speculate how blockchain concepts can be applied to continuous integration and package management in SE (Beller 2019). However, little is known about how software engineers actually develop blockchain applications and the tools and processes they use compares to traditional software engineering work. Thus, this study seeks to empirically analyze the SE practices used to build blockchain technologies and the challenges that developers of these applications face. Our goal is to design future tools and techniques to better support blockchain developers and help improve their programming behaviors and productivity.

# Statistical Analysis Plan

* 1. Describe the statistical methods that will be used to analyze the data you collect.

We will average the responses from Likert scale questions and use non-parametric tests to quantitatively analyze these data. Open-ended answers will be analyzed using an open coding technique and Cohen’s Kappa will be used to measure the rate of agreement between the coders.

# Procedures Involved

* 1. Provide a description of:
     + All research procedures being performed. Start with recruitment and end with when participation is complete.
     + Include the estimated duration of participant’s participation (i.e., how long will it take participants to complete survey(s), questionnaire(s), focus group(s), or educational test(s)?).
     + If the research involves deception include a justification (why it is necessary) and describe the debriefing process. You will need to request and justify an alteration of the consent process in section 12.2.

The research procedures include a survey to collect data on software engineers’ experiences with blockchain technologies. The survey will ask participants about the SE tools and processes used to develop blockchain applications. Participants will be professionals in the software industry age 18 and older recruited via social media (i.e. Twitter) and personal contacts. Prospective participants who view the post will be directed to a webpage containing information about the research study and a link to the survey with the option to complete it. In the survey, participants also have the option to sign up for an interview to provide more information. Participants who sign up will provide their contact information to be contacted by the research team to schedule the interview. The interviews will take place over Zoom and will be audio and/or video recorded. The interview will be semi-structured and will allow developers to provide more open-ended insight into their experiences developing blockchain applications. The survey will take approximately 10 minutes and interviews will last no more than an hour. Participants can withdraw from the survey or interview at anytime without consequence. No deception will be used in this study.

Please select the methods that you will use to collect data about participants. Upload all data collection forms to Protocol Management.

| ☐ | Screening questionnaire(s) |
| --- | --- |
| 🗸 | Survey(s), including online survey(s) |
| ☐ | Demographic questionnaire(s) |
| 🗸 | Interview guide(s) or question(s) |
| ☐ | Focus group(s) |
| ☐ | Other, please specify**:** Click here to provide a response. |

* 1. What data will you collect during the study and how you will obtain them? Please include the name of the software and descriptions of electronic data collection, database matching, and app- or device-based data collection. If third party software will be used, please provide the name of the software, and indicate if you have confirmed that the software has been approved for use (see [https://vt.cobblestone.software/public/).](https://vt.cobblestone.software/public/)

The survey will collect Likert scale and open-ended responses on developers’ experiences with processes used to program blockchain applications. The interview will collect further open-ended questions on participants’ perceptions of SE tools and processes to develop blockchain technologies. The survey will be implemented on the Virginia Tech instance of QuestionPro. The interview will be held on Zoom.

* 1. Will your research involve any audio and/or video recordings?

🗸 Yes, respond to question 5.4

☐ No, skip to question 5.5

* 1. Who will transcribe or code audio and/or video recordings? If third party software will be used, please provide the name of the software, and indicate if you have confirmed that the software has been approved for use (see <https://vt.cobblestone.software/public/>).

Zoom will be used to automatically transcribe the audio recordings from the interviews. The transcriptions will be manually analyzed and coded by the research team. If a participant agrees to participate in the study but does not consent to being recorded, then the data will be collected and analyzed via interviewer notes.

* 1. Please select the identifiers you will obtain (whether directly from participants or from another source). The collection of social security numbers, student records, including grades and assignments, may require approval from Virginia Tech data stewards prior to use. Please contact the Privacy and Data Protection Program at [prdp@vt.edu](mailto:prdp@vt.edu) for information on additional approvals*.*

| 🗸 | Name |
| --- | --- |
| ☐ | Geographical subdivisions smaller than a state, including street address, city, county, precinct, zip code, and equivalent geocodes (note, the initial three digits of a zip code are not considered identifiable) |
| ☐ | Elements of dates (except year) directly related to an individual, including birth date, admission date, discharge date, date of death, and single year of age over 89 and all elements of dates (including year) indicative of such age (note, such ages and elements may be aggregated into a single category of age 90+) |
| ☐ | Phone numbers |
| ☐ | Fax numbers |
| 🗸 | Electronic mail addresses (e-mail) |
| ☐ | Social Security numbers |
| ☐ | Medical record numbers |
| ☐ | Health plan beneficiary numbers |
| ☐ | Account numbers |
| ☐ | Certificate/license numbers |
| ☐ | Vehicle identifiers and serial numbers, including license plate numbers |
| ☐ | Device identifiers and serial numbers |
| ☐ | Web Universal Resource Locators (URLs) |
| ☐ | Internet protocol (IP) address numbers |
| 🗸 | Biometric identifiers, including finger and voice prints (audio recording) |
| ☐ | Full face photographic images and any comparable images (including video recording) |
| ☐ | Student record number or identification number |
| ☐ | Student grades or classroom assignments |
| ☐ | Username for online or computer accounts |
| ☐ | Any other unique identifying number, characteristic, or code (note this does not mean the unique code assigned by the investigator to code the data)**:** Click here to provide a response. |

# Participant Population

* 1. Provide a general description of the individuals who will be included in your study (e.g., Virginia Tech undergraduate students, a national sample of adults with engineering degrees) and how you will screen them for eligibility.

Participants will be professional software engineers 18 years or older. In the survey, we will ask respondents to provide the name of the company they work for and their job title, as well as their experience working on blockchain technologies. Additionally, before completing the survey participants will be notified they must be 18 years or older to participate.

* 1. Provide the geographic location of where you will recruit participants (e.g., New River Valley; Blacksburg, VA; Paris, France).

Virtual

* 1. Describe any populations or groups that you will target for inclusion in or exclusion from your sample. Please indicate why these groups have been selected and how your participant selection is equitable.

We will target professional software developers to gain insight into their experiences with tools and processes developing blockchain technologies. Participant selection is open to anyone who is a software engineer with or without blockchain development experience over 18 that agrees to participate

* 1. Will your research involve individuals who are vulnerable (pregnant women, minors, prisoners, adults with decisional impairment, students, and individuals who are economically or socially disadvantaged)? Pregnant women should be included in minimal risk studies that pose no risk to the woman or fetus.

☐ Yes, respond to question 6.5

🗸 No, skip to question 6.6

* 1. Please specify which vulnerable populations you are including and provide justification for including these individuals. Describe additional safeguards you will include to protect their rights and welfare.

Click here to provide a response.

* 1. Indicate the total number of participants to be enrolled and how this number was determined (e.g., sample size calculation [show], number of available participants in a finite pool, number of tests funding award would allow).

We would like to recruit as many participants as possible. We are aiming for a minimum of 25 survey responses and 10 interview participants.

# Recruitment Methods

* 1. Describe when, where, and how you will recruit potential participants. If recruitment will be online, include the name(s) of participant management system (e.g., Ripple), the social media platform or online forums that you will use, include web address and contact information (for example MTURK, Facebook, Twitter, or Reddit). If recruitment will be in person include the specific location(s) (e.g., students in the library, community members at a gathering, or members of a local gym) and the methods that you will use to identify potential participants.

We will begin recruiting survey participants as soon as the study is approved by the IRB. Recruitment will take place online via emails to personal contacts who are professional blockchain developers and posts seeking participants in software engineering communities on Twitter, Reddit, and Slack. Interview participants have to volunteer through the survey.

* 1. Describe materials that you will be used to recruit participants. Use the Worksheet on Advertisements [HRP 315.1](https://www.research.vt.edu/content/dam/research_vt_edu/hrpp/files/worksheets/hrp-315-worksheet-advertisements.docx) as a guide. Attach final copies of these documents with this protocol in Protocol Management and be sure to include the IRB protocol number on each document.
* For flyers, attach the final copy of printed flyers.
* For Virginia Tech News, Facebook postings and ads, newspaper ads, websites, MTurk/SONA/online survey systems, etc.
* For email recruitments, please include the subject line as well as the text.
* For advertisements meant for audio or video broadcast, please submit the wording of the advertisement prior to taping (to avoid having to re-record with approved language) and submit the final recorded version for IRB review before use.
* Describe any payment to participants. Please review [HRP 092.1](https://www.research.vt.edu/content/dam/research_vt_edu/hrpp/files/sops/sop-hrpp-092.1-payments-to-research-participants.pdf) *Payment to Research Participants* to ensure you are following the most recent guidance. Separate payments into appropriate categories, such as reimbursement for expenses, time and effort, and additional incentives for study participation. For each category, specify the amount (including any pro-rated amount), schedule, and method of payment.

Recruitment materials will include emails to personal contacts and posts on social media to request participation in the survey. For survey respondents who would like to provide additional information, they can sign up for an interview. Participants will be compensated for participation by being included in a raffle for a $50 Amazon gift card.

# Risks to Participants

* 1. List the reasonably foreseeable risks, discomforts, hazards, or inconveniences to the participants related to their’ participation in the research. Include a description of the probability, magnitude, duration, and reversibility of the risks. Consider physical, psychological, social, legal, privacy, reputational, and economic risks. **Do not indicate “no risk” or “N/A.”** Instead, for studies with very low risk (e.g., anonymous online survey on a mundane topic) indicate “The investigators are not aware of any risks from participation in this study.” or “No more than risks that are found in everyday life.” Common risk types include:
* Psychological (e.g., potential for stress, discomfort, and/or embarrassment)
* Social (e.g., potential for discrimination or stigmatization and disruption of personal and family relationships)
* Legal (e.g., potential for disclosure of illegal activity, negligence)
* Privacy (e.g., potential for personal information being accessed, used, or disclosed without the participants’ knowledge or consent, breach of confidentiality/security)
* Reputational (e.g., loss of stature in the community, in business, or negative media coverage)
* Economic (e.g., potential for individuals to lose access to economic services, employment, insurability)

The study will consist of a confidential survey and an optional interview. The researchers are not aware of any risks involved in participating in this study.

* 1. Describe procedures or safeguards intended to reduce the probability and magnitude of risks.

The researchers will incorporate safeguards to ensure the confidentiality and privacy of participant responses. Participants will be able to schedule the interview at a time and location (Zoom or phone call) of their convenience. We will incorporate Zoom security features such as meeting passcodes and enable the waiting room for participants to join to ensure privacy. No identifiable information is collected unless participants would like to sign up for a survey. All data collected will be stored in a secure location only accessible by the research team. Survey responses and interview recordings will be stored with an anonymized participant ID instead of identifying information. Participation will be voluntary and participants can leave the survey or interview at any time without consequence.

* 1. If applicable, describe risks to others who are not participants (e.g., mandatory reporting of abuse, unflattering results generalized to identifiable or vulnerable communities):

We will ask participants to avoid using any names or identifying information for individuals in their responses for the survey and interview.

# Potential Benefits to Participants

* 1. Describe the potential benefits individual participants might experience from participating in the research. Include the probability, magnitude, and duration of the potential benefits. Do not include benefits to society or others. Do not list monetary or non-monetary compensation for participation, as this is not a benefit. If there are no anticipated direct benefits for participants, please state that below.

There are no direct benefits for individual participants.

# Data Management and Confidentiality

* 1. Describe procedures that you will use to ensure the validity of collected data.
* How will you prevent the data from being inadvertently changed?
* How will data be accessed by the study team?
* How will you prevent those not on the study team from accessing the information?
* How will you back up your data to protect them from loss?
* How will you ensure that all copies of the data will remain at Virginia Tech when there is a change in study personnel?

Survey responses will be stored in an exported spreadsheet from QuestionPro and interviews will be recorded and stored as .mp4 or audio files. Collected data will be stored in a private folder on the Virginia Tech instance of Google Drive. The folder will only be shared with the research team and be inaccessible to anyone else. The machine where the data will be collected meets the Virginia Tech security requirements.

* 1. From the list below check all the processes you will use to handle and secure study data during collection, storage, use, and transmission. Describe the process in the text field. Keep in mind that data is owned by Virginia Tech and must be stored on the university’s resources. Helpful resources are available on the Privacy and Research Data Protection Program [website](https://www.research.vt.edu/sirc/prdp/resources.html). Include information about:

🗸 Training of study staff

🗸 Authorization of access

☐ Password protection

☐ Encryption

☐ Physical controls

🗸 Separation of identifiers and data

☐ Equipment or devices data to be used to collect or store data

☐ Other, specify below

The graduate students have taken a course on responsible research ethics through the CS department (CS5014/CS5024) and complete the CITI Training. Undergraduate students will also complete the CITI training. The data will be stored in a private Virginia Tech Google Drive folder with google sync disabled and access only being provided to members of the research team. Google sync will not be used. The survey does not collect identifying information unless the participant provides it to complete an interview. Survey responses and interview recordings will be stored with a confidential participant ID. The key linking the identities of participant IDs will be stored in a different location than the research data on the Virginia Tech secured and managed Google Drive. Only the research team will have access to a key mapping the participants to their ID for those who complete both the survey and interview.

* 1. Do you plan to store data online or in the cloud?

🗸 Yes, respond to question 10.4

☐ No, skip to question 10.5

* 1. Please indicate the location of storage and any software used to access or input data. Please ensure that the data storage and software have been approved for use for Virginia Tech. You can review the list of approved software and data storage services at <https://vt.cobblestone.software/public/>. If you need assistance determining an appropriate location for your data or confirming software or storage have been approved, please contact the Privacy and Research Data Protection Program at [prdp@vt.edu](mailto:prdp@vt.edu).

Virginia Tech instance of Google Drive

* 1. Does your research involve collaborators from other institutions or organizations?

☐ Yes, respond to question 10.6

🗸 No, skip to question 10.7

* 1. For collaborative projects, describe how data will be handled and secured. If a central storage mechanism will be used, please indicate which institution is hosting the data:

Click here to provide a response.

* 1. Describe the plan for data disposition following the conclusion of the study (e.g., long-term archive of data, data destruction).
     + How long will the data be stored?
     + Where and how data will be stored?
     + What information will be included in the long-term storage of data?
     + When and how will personal identifiers be destroyed?
     + Who will have access to the data during long term storage?
     + Will you make the data available through a public or curated archive? Are you obligated to do so by a sponsor/grant agreement?

The data will be collected on a personal machine that meets the Virginia Tech security requirements for low risk. Data will be stored on a Virginia Tech secured and managed Google Drive folder until the publication of the work and/or the thesis of the graduate student project. After this, the mapping key will be destroyed and collected survey data will be de-identified and stored in a public GitHub repository for future work and researchers to further explore. The interview recordings will be privately stored in a Google Drive folder accessible by the PI for further analysis or future work. The long term storage data will include the survey questions and responses from participants. The PI will have control over the long term storage data to share with future students who build on this work or other researchers interested in this area.

# Provisions to Protect the Privacy Interests of Participants

* 1. Describe the steps that you will take to protect participants’ privacy interests. “Privacy interest” refers to a person’s desire to place limits on with whom they interact or to whom they provide personal information (e.g., collecting the minimal amount of private information required to complete the study, protecting the data once it is obtained, obtaining a Certificate of Confidentiality).

The survey will collect a minimal amount of private information. No identifiable information is required unless the participants wish to provide more details in an interview. The information provided will only be used to contact the participant to schedule the interview and will not be stored with the survey. The participants company and role are used to verify participants and will be presented in aggregate to describe the survey population.

* 1. Describe steps that you will take to make participants feel at ease with the research situation in terms of the questions being asked. “At ease” does not refer to physical discomfort, but the sense of intrusiveness a participant might experience in response to questions, making it clear on surveys that participants can discontinue at any time, not asking questions about private or sensitive issues unless necessary for the research.

The survey and interview intros will acknowledge that participants can quit at any time. The survey only asks about general experiences and perceptions of SE tools and processes for developing blockchain technologies. The interview will ask open-ended questions about experiences and challenges with developing blockchain applications to gain feedback about ways to better support blockchain developers in their work. The interviewers will be provided with a script of questions and can only ask clarifying or follow up questions based on participant responses. Participants can also decline to answer a question without penalty.

* 1. Describe any required reporting that might occur because of your research questions, study populations, and data collection methods. Examples of required reporting in the Commonwealth of Virginia and Virginia Tech include:
  + **Any** suspicions (e.g., circumstantial, disclosed) of child abuse (physical, emotional, sexual) and neglect
  + Sexual discrimination and/or sexual violence that involves a student
  + Disclosure or signs of intention to harm oneself (i.e., suicidal ideation and/or plan)
  + Disclosure or signs of desire to harm others (i.e., homicidal ideation and/or plan)
  + Suspected abuse, neglect, or exploitation of vulnerable adults (e.g., individuals with a disability, elderly persons)

N/A

# Consent Process

* 1. Indicate the process by which you will inform participants about the study and determine their voluntary decision to participate. If consent is implied that process should be described here. Please upload the information sheet and scripts referenced in this section to Protocol Management.

Consent for the survey will be implied by participants filling out the online survey. Participants will receive an overview of the study and will be able to view the questions before submitting their responses. If a participant completes the survey and decides to withdraw their responses, they can contact the research team at the email address provided to remove their info. For interviews, consent will be implied by participants filling in their contact information to schedule the interview. Furthermore, the interviewer will explicitly ask participants to provide verbal consent to complete the interview and for the session to be recorded. Interview participants will be able to ask questions to the interviewer, who will be a member of the research team, about the study before consenting to participate. Participants will receive the information sheet prior to completing the survey. Interview participants will receive another information sheet before their interview after their session has been scheduled.

* 1. Does your research involve Non-English speaking participants?

☐ Yes, respond to question 12.3

🗸 No, skip to question 12.4

* 1. Indicate what language(s) other than English are understood by prospective participants or representative and describe the process you will use to ensure that the information will be provided in a language that they understand.

Click here to provide a response.

* 1. Does your research involve participants who are not yet adults (minors: infants, children, teenagers)?

☐ Yes, respond to question 12.5

🗸 No, skip to question 12.6

* 1. Describe the criteria that you will use to determine legal age for consent to treatments or procedures involved in the research under the applicable law of the jurisdiction in which the research will be conducted (e.g., in Virginia, individuals under the age of 18 years). Make sure you include the appropriate consent or assent template. If you are unsure which one to include contact the HRPP at [irb@vt.edu](mailto:irb@vt.edu). The inclusion of children includes some restrictions and additional information might be needed.
* For research conducted in Virginia, review “SOP: Legally Authorized Representatives, Minors, and Guardians ([HRP-013](https://www.research.vt.edu/content/dam/research_vt_edu/hrpp/files/sops/sop-hrpp-013.1-lars-minors-and-guardians.pdf))” to determine which individuals in the state meet the definition of “minor.”
* For research conducted outside of the Virginia, please describe the legal requirements for that state’s or locality’s definition of “minor.”

Describe the process for obtaining parental permission. Federal requirements state that:

* Permission from one parent is acceptable for studies that involve no greater than minimal risk OR involve greater than minimal risk but present the prospect of direct benefit to the minor participant.
* Permission from both parents is required in all other cases (unless one parent is deceased, unknown, incompetent, or not reasonably available, or when only one parent has legal responsibility for the care and custody of the minor).

Describe whether you will obtain permission from individuals other than parents or legally authorized representatives, and if so, who will be allowed to provide permission. Describe the process you will use to determine these individuals’ authority to consent to the minor’s general medical care.

* Indicate whether you will obtain assent from all, some, or none of the minors. If you will obtain assent from some minors, indicate which minorswill be required to assent. Consider chronological age and intellectual capacity when determining who will be required to provide assent (e.g., infants are unable to assent, while teenagers are likely able to read and sign an assent form).
* When assent of minors is obtained, describe whether and how you will document it. Will minors sign an assent form or give verbal assent?

Click here to provide a response.

* 1. For research that involves deception describe how the study meets all of the following criteria for an alteration of the consent process:
* The research involves no more than minimal risk to the subjects
* The alteration will not adversely affect the rights and welfare of the subjects
* The research could not practicably be carried out without the alteration/deception
* (Optional but encouraged in most cases) Subjects will be provided with additional pertinent information after participation (i.e., debriefing for studies involving deception)

N/A