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UUT22 A novel and reliable Decision Support System (DSS) on recovery route selection in transport logistics for volunteer teams

Seda Sucu, Mathematics and Physics, Faculty of Technology,
University of Portsmouth, UK

Nataliia Volkova, Department of applied mathematics and
information technologies, Institute of Computer Systems, Odessa
Polytechnic National University, Ukraine



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1. The purpose of the project and subjects of the investigation

1. The purpose of the project

Increasing the reliability of decision-making for the tasks of transport logistics for teams of volunteers in conditions of dynamic changes in the external environment during and post-crisis.



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2. Tasks of the project

Tasks of the project are ...

- Development of a questionnaire for an online survey.
- Collect data from users using an online survey platform.
- Analysis of online survey results to identify important criteria that affect the decision making process in conditions of dynamic changes in the external environment during and post-crisis.
- Develop method of forming collective expert volunteer's assessment.
- Develop project of the mobile Decision Support System (mDSS) for support the volunteer team.



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3. Waiting for project results

Waiting for project results are

1. One conference paper.

2. One journal paper.





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4. Road map of the project

Road map of the project

No	Research Phase	Time Slot
1	Preparation of survey questions. Preparation of an information sheet for the survey participant. Literature review.	02.05.2023/ 31.05.2023
2	Preparation of an article in the scientific publication of Ukraine "Herald of Advanced Information Technology". Development of a survey questionnaire.	01.06.2023/ 17.07.2023
3	Conducting a survey. Preparation of theses of the conference.	18.07.2023/ 10.08.2023
4	Processing of survey results. Writing sections for journal.	11.08.2023/ 31.08.2023



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5. Obtained project results



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Survey structure

Survey			
Section 1	Section 2	Section 3	Section 4
Route	Maintenance and use of vehicle	Communication	People



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Survey structure

Route				
Safety of the route	Route length	Availability of the route	Road condition	Threat level of the area



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Survey structure

Maintenance and use of vehicle				
Possibility of refueling	Possibility of repair	Transportation speed	Reliability of transportation	Ability to protect transport



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Survey structure

Communication

Availability of means of communication

People

Availability of
medical care

Availability of places
to rest and sleep



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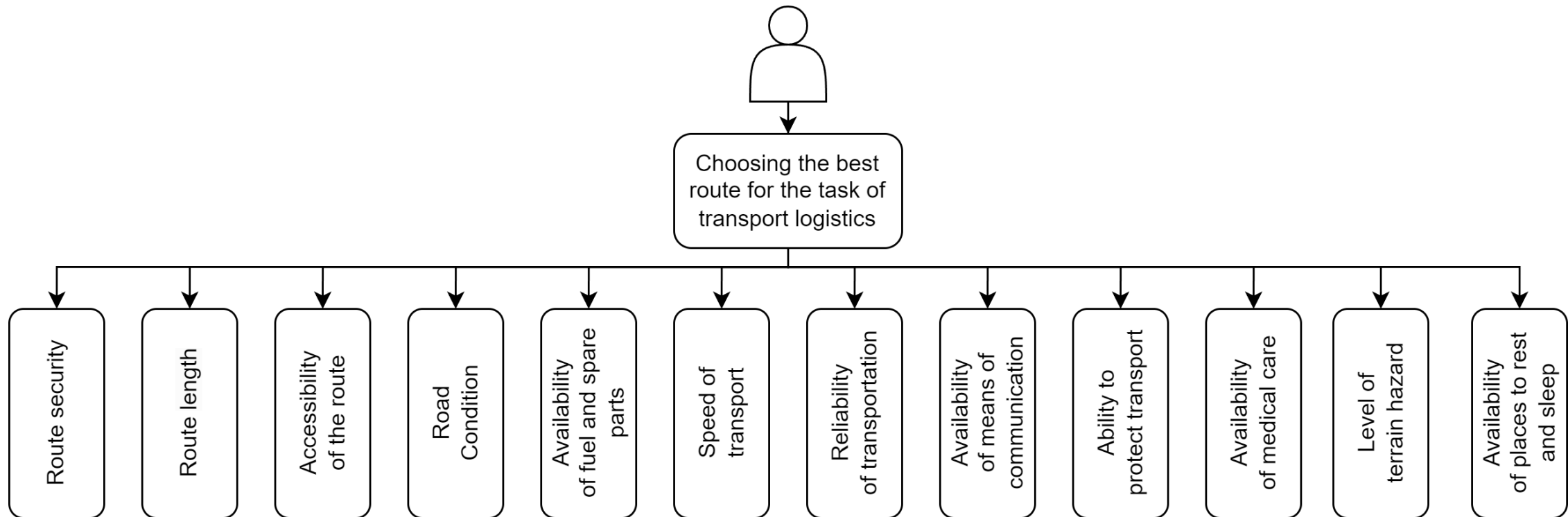
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Analysis of online survey results

Analytic Hierarchy Process method



Pairwise comparison matrix

	1	2	3	4	5	6	7	8	9	10	11
1	1	9	7	5	3	1	1/3	1/3	1	1/3	1/5
2	1/9	1	1	1/7	1/5	1/3	1/5	1/5	1/5	1/5	1/7
3	1/7	1	1	1/9	1/7	1/3	1/7	1/5	1/3	1/5	1/7
4	1/5	7	9	1	2	2	3	2	4	4	4
5	1/3	5	7	1/2	1	3	1	1	1	1	1/3
6	1	3	3	1/2	1/3	1	1/5	1/3	1/7	1/7	1/7
7	3	5	7	1/3	1	5	1	1/7	1	1	1/3
8	3	5	5	1/2	1	3	7	1	1/3	1/3	1/7
9	1	5	3	1/4	1	7	1	3	1	1/3	1/3
10	3	5	5	1/4	1	7	1	3	3	1	1
11	5	7	7	1/4	3	7	3	7	3	1	1

Pairwise Comparison Matrix Scale

Intensity of Interest	Definition
1	One element is as important as the other elements (<i>equal importance</i>)
3	One element is slightly more important than the other elements (<i>moderate more importance</i>)
4	One element is clearly more important than the other elements (<i>essential, strong more importance</i>)
7	One element is clearly more important than the other elements (<i>demonstrated importance</i>)
9	One element is absolutely more important than the other elements (<i>absolutely more importance</i>)

	1	10	4	8	5	9	6	7	3	2	11
Weight	0,16402	0,09797	0,09120	0,08725	0,08678	0,08294	0,05407	0,03932	0,03251	0,02621	0,02542

$$C_1 \succ C_{10} \succ C_4 \succ C_8 \succ C_5 \succ C_9 \succ C_6 \succ C_7 \succ C_3 \succ C_2 \succ C_{11}$$

Result

	1	10	4	8	5	9	6	7	3	2	11
Weight	0,16402	0,09797	0,09120	0,08725	0,08678	0,08294	0,05407	0,03932	0,03251	0,02621	0,02542

$$C_1 \succ C_{10} \succ C_4 \succ C_8 \succ C_5 \succ C_9 \succ C_6 \succ C_7 \succ C_3 \succ C_2 \succ C_{11}$$

C_1 – Safety of the route

C_{10} – Availability of medical care

C_4 – Road condition

C_8 – Availability of means of communication

C_5 – Possibility of refueling and repair

C_9 – Ability to protect transport

C_6 – Transportation speed

C_7 – Ability to protect transport

C_3 – Availability of the route

C_2 – Route length

C_{11} – Threat level of the area

Method of forming collective expert volunteer's assessment

Model of decision-making support of a team of volunteers

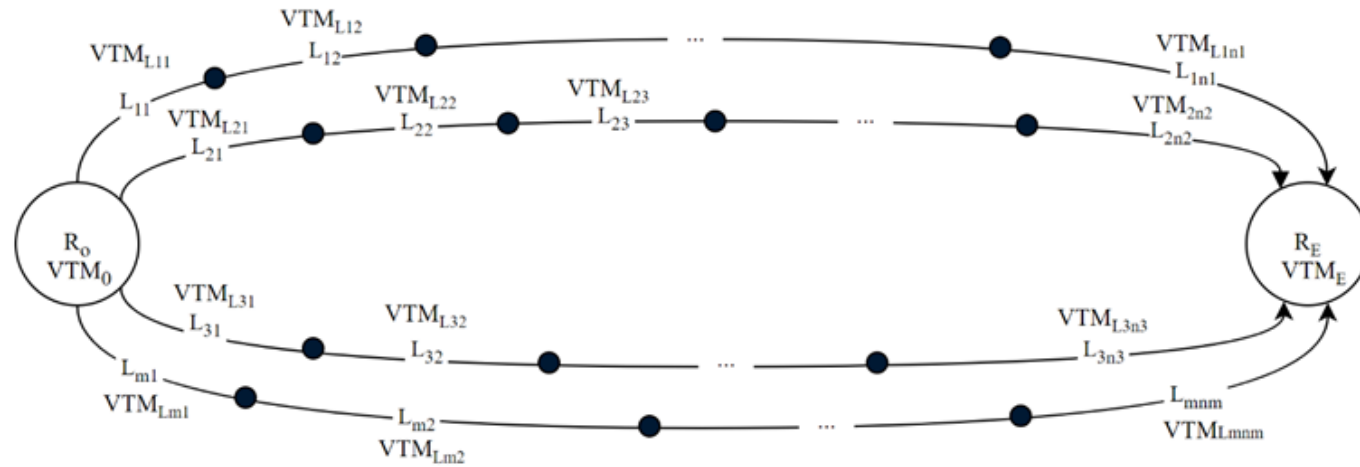
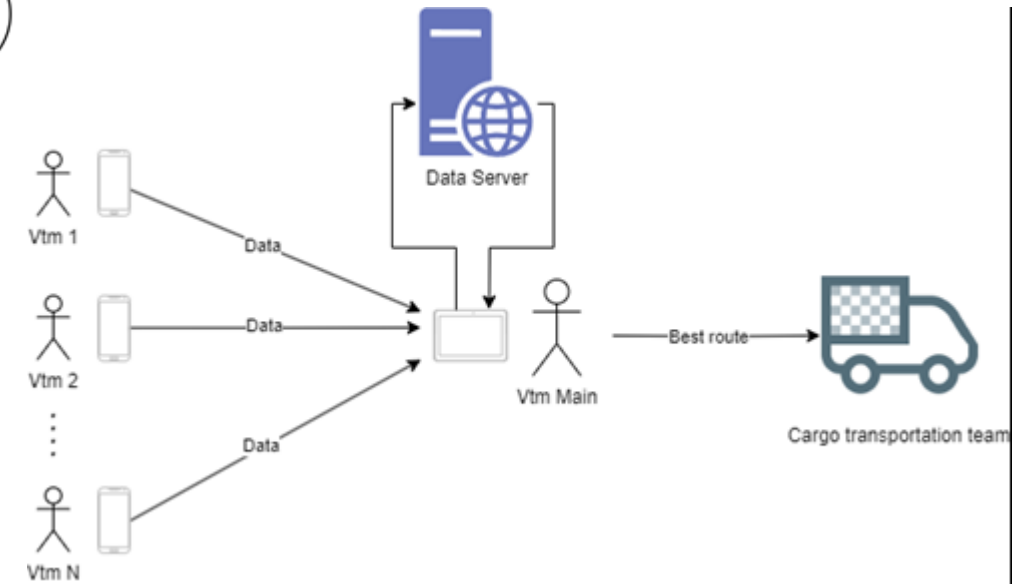


Fig. Model of decision-making support of a team of volunteers regarding the operational choice of the best logistics route





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The method steps:

Step 1. Formation of an extended list of indicators for assessing the current state of the route.

Step 2. Aggregation of expert assessments of these indicators taking into account the types of data.

In the case of a qualitative evaluation, assign R_i^k ranks to the evaluations of the route (Table):

Table . Assignment of ranks to qualitative evaluations of indicators

Qualitative assessment	very bad	bad	satisfactorily	good	perfectly
Rank	1	2	3	4	5

Then the average rank is calculated $\overline{R}_i = \sum_{k=1}^n \frac{R_i^k}{n}$ with subsequent finding of its whole part in

the decreasing direction $C_i^{agr} = \left\lfloor \frac{\overline{R}_i}{n} \right\rfloor$, which is replaced by an appropriate qualitative indicator.



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The method steps:

In the case of a quantitative assessment, calculate the average assessment for each section of the route:

$$C_i^{agr} = \sum_{k=1}^n \frac{C_i^k}{n}.$$

In case of relay assessment:

$$\begin{cases} C_i^{agr} = 1, \text{ If 2/3 of volunteer experts gave a "yes" rating} \\ C_i^{agr} = 0, \text{ in the other case} \end{cases}$$

Thus, based on the aggregation of the vector of evaluations of the route sections into which the route is divided, received from volunteer experts, a vector of collective expert evaluation of the relevant indicators $C_L^{agr} = [C_1^{agr}, C_2^{agr}, C_3^{agr}, C_4^{agr}, C_5^{agr}, C_6^{agr}, C_7^{agr}, C_8^{agr}]$ for the entire route is formed.



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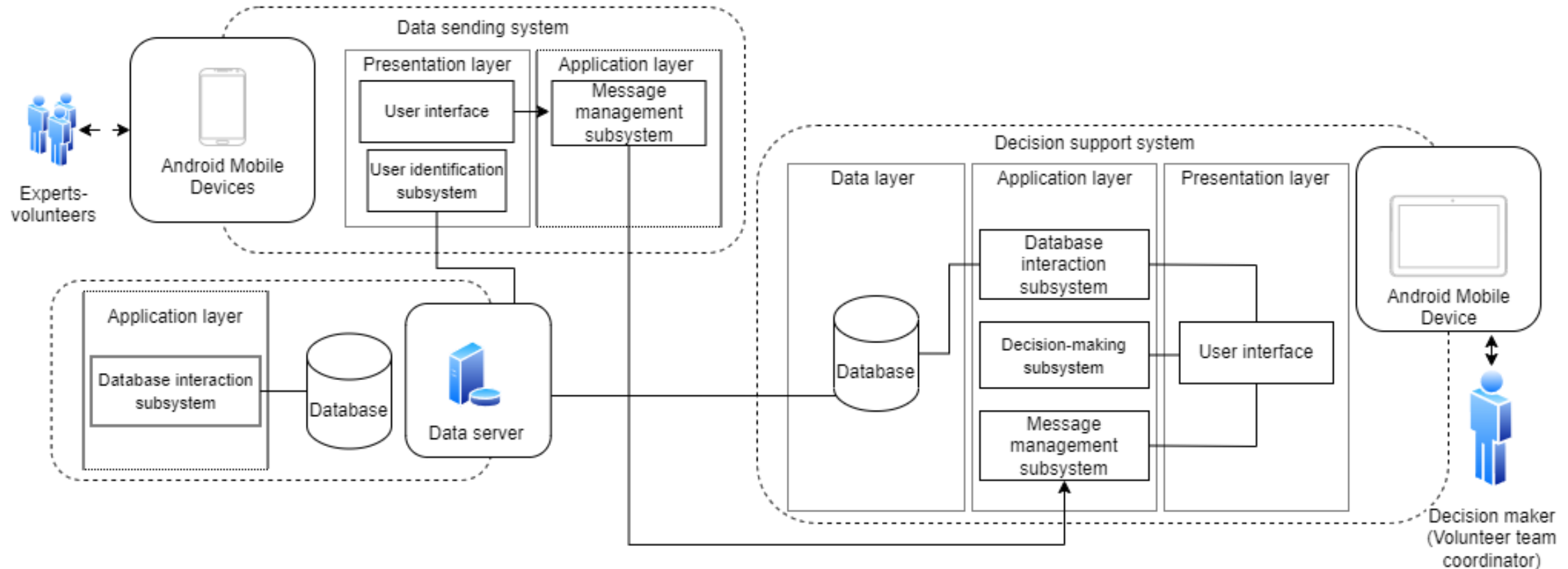
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Project of the mobile Decision Support System (mDSS) for support the volunteer team

The architecture of the of mDSS





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6. Summary of the results



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Summary of the results

Two conference papers:

1. Д. Р. Горпенко, В. О. Болтъонков. Модель формування колективної оцінки поточного стану маршруту експертами-волонтерами в умовах динамічної зміни обстановки // Матеріали 1-ї Міжнародної наук. практ. конф. «New ways of creating scientific ideas for implementation», 18-20 вересня 2023 р., Варна, Болгарія. - С. 241-244.
2. Д. Р. Горпенко, В. О. Болтъонков. Метод підтримки прийняття рішень командою волонтерів при виборі найкращого маршруту для вирішення задач оперативної транспортної логістики // Матеріали 1-ї Міжнародної наук. практ. конф. «Distance learning in modern conditions and new technologies», 19-22 вересня 2023 р., Стокгольм, Швеція. - С. 221-224.

One journal paper:

1. Horpenko D. R. "Architecture of a mobile transport route selection system by a team of volunteers in the conditions of the military state". *Herald of Advanced Information Technology*. 2023; Vol. 6 No.2: 174 – 184. DOI: 10.15276/hait.06.2023.12

Acknowledgment

This project was made possible through the UK-Ukraine twinning grants scheme, funded by Research England with the support of Universities UK International and UK Research and Innovation



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Thank you very much for your attention!

Seda Sucu: seda.sucu@port.ac.uk

Nataliia Volkova: volkova.n.p@op.edu.ua

<https://op.edu.ua/international/projects/uk-ukraine-twinning-initiative-22>