complex. The objective is to distribute the training in qualifications of onboard complexes between cosmonauts so that the total time of training was minimal. It can be formulated in different ways [2]:

$$(\max_k \tau_k - \min_k \tau_k) \to \min, \quad k \in \mathcal{K}, \tag{1}$$

$$\max_k \tau_k \to \min, \quad k \in \mathcal{K}, \tag{2}$$

$$\min_k \tau_k \to \max, \quad k \in \mathcal{K}. \tag{3}$$

where $\mathcal{K}$ – set of cosmonauts, τ_k – total time of training of cosmonaut k.

For this problem, two algorithms are presented. The first one is a heuristic which iteratively by onboard systems choose such qualification to train that provide optimal objective value. The second one consists of a heuristic and exact parts, and is based on the n-partition problem approach.

Calendar planning.

The next important step of the planing is a calendar scheduling. Once solved the volume problem for each cosmonaut defined set of tasks which they should do. The objective of calendar planing is not defined but now we use the next: minimizing time of preparation of the first crew to start. Planing should comply with resource constraints and deadlines of the preparation of other crews. The problem is formulated as resource constrained project scheduling problem (RCPSP) and integer programming problem.

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Two-station single track railway with a siding scheduling problem

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A railway connection of two stations by a single railway track is usually found on branch lines of railway network and is very common in various manufacturing supply chains. One of the earliest research of single track scheduling problem is the publication of Szpigel [5]. Since this work scheduling problems, where trains are using a single railway track, remained the subject of intensive research. In 2011 Lusby et al. [2] published an article with a survey of publications on railway scheduling methods and models with a section on single track scheduling problems. A literature review on the single track railway scheduling problem can be found in the Ph.D. thesis of Oliveira [3] which is concerned with application of constraint programming method. Sotskov and Gholami [4] considered single track scheduling problem with several stations and proposed heuristic algorithm. The reduction of the two-station single track railway scheduling problem to the single machine scheduling problem with setup-times can be found in recent work of Gafarov et al. [1].

Our paper is concerned with a scheduling problem for two stations with a single railway track with one siding. On single-track railway sidings or passing loops are used to increase the capacity of the line. The problem involves two stations which will be referred to as station A and station B. All trains are split into two sets. The trains, constituting set N_1, need to travel from station A to station B. The trains, constituting set N_2, need to travel from station B to station A. All trains are available at the beginning of the planning horizon and have an equal constant speed. The single track, connecting station A and station B, has a siding – a short track at the side of the main railway line that allows two trains to pass each other when they are moving in opposite directions. Since the length of the siding is relatively small, it is assumed that trains pass the siding instantly.

In the schedule it is necessary to specify for each train its departure time.

If a train uses the siding, then its stay time in the siding is also part of the schedule. The objective is to find a schedule that minimises the time needed to complete all transportations. This objective function will be denoted C_{max} and will be referred to as the makespan.

In our paper we developed exact optimization algorithm by analysing the structure of optimal schedule for the proposed model. The algorithm produces a schedule that completes all transportations between two stations at minimal time. We present algorithm to construct an optimal schedule in O(1) operations. Optimal schedule analyse allows the development of exact optimization algorithms with other models and objective functions, i.e. results can be generalized and used in future work for a number of regular objective functions, commonly used in scheduling.

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COPERNICUS GOLD, Global Financial System

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COPERNICUS GOLD is a blockchain-based global transaction settlement and accounting system.

Cutting-edge Blockchain technology (BT) combines a transaction recording, digital signing and validating. This innovation allows for transfers without mediators to validate their execution. Open keys exchange for digital signing and their third party verification are no longer needed. Besides recording transactions Blockchain guarantees data integrity and reliability. Now the global financial system is a hierarchy of financial institutions, each performing separate tasks at different process levels. As telecoms emerged, a SWIFT system appeared to set standards of settlement and security transaction execution and validation. **The current global monetary system consists of** *Issuers* – the US FRS and other countries' Central Banks issuing unbacked (fiat) national currencies, ***SWIFT*** - international money transfer via banks correspondent accounts and *Commercial banks* – payment effecting and accounting. **Organized security circulation is supported by** *Depositories and registrars* - accounting of securities, *SWIFT and its analogues (Reuters Dealing, TARGET)* – security and currency trading, Exchanges - security/currency transaction recording in accordance within relevant regulations *Brokers* - retail clients' access to stock exchanges. The global financial system hardware support advanced but functions and concepts stayed nearly the same. It is archaic and lags behind IT development.

Banking system hierarchy makes international payments go through correspondent accounts instead of direct customer-to-customer transfer. It results in payment delay and shifts banking on retail clients turning a single major bank bankruptcy a threat to all the system. **The total cost of interbank settlements for end users is quite high and includes**: settlement fees, price of financial (exchange difference) and systematic risks (financial crises), cost of related services (payment cards; e-money with reference to national currencies, etc.), cost of bureaucratic overregulation.

Copernicus Gold as a new stage in digital currency development.

Interbank settlements' ineffectiveness forced searching for alternative solutions, such as that of electronic not supervised by Central Banks: Among them were *Digital gold* – isolated payment system with currency linked to gold and backing guaranteed by issuer, *Digital money* - issuer guarantees its buying out, and *Unbacked digital money* - local exchange system of cryptocurrencies and