

CLAIMS

1. An operation command generation device, comprising:
an execution order determination unit configured to deter-
mine, based on respective arrangement positions of a
plurality of process symbols each representing a pro-
cess for a process subject on a protocol chart compris-
ing the plurality of process symbols, an execution order
of the plurality of process symbols; and
a process symbol conversion unit configured to respec-
tively convert the plurality of process symbols into jobs
for a process system comprising at least a robot so that
processes represented by the plurality of process sym-
bols are executed in the execution order determined by
the execution order determination unit;
wherein the protocol chart further comprises an initial
symbol with which at least one process symbol is
associated, the initial symbol representing a container
for the process subject,
wherein some of the process symbols are arranged along
a first direction from the initial symbol,
wherein another initial symbol is arranged being separate
from the initial symbol in a second direction intersect-
ing the first direction, and the former initial symbol and
the latter initial symbol represent different containers,
and
wherein the execution order of the processes represented
by the process symbols arranged at equal position in the
first direction is determined according to their position
in the second direction.
2. The operation command generation device according to
claim 1,
wherein the operation command generation device further
comprises an initial symbol conversion unit configured

to convert the initial symbol into a job of preparing the container for containing the process subject.

3. The operation command generation device according to claim 1,

wherein the protocol chart further comprises an initial symbol with which at least one process symbol is associated, the initial symbol representing a container for the process subject,

wherein the operation command generation device further comprises a number-of-containers extraction unit configured to extract a number of containers associated with the initial symbol based on the protocol chart, and wherein the process symbol conversion unit is further configured to convert the process symbol associated with the initial symbol into as many jobs as the number of containers extracted by the number-of-containers extraction unit.

4. The operation command generation device according to claim 1,

wherein the protocol chart further comprises a parallel process symbol arranged so as to be associated with a process symbol,

wherein the operation command generation device further comprises a parallel process setting unit configured to make such a setting that a first process represented by the process symbol and a second process are to be simultaneously executed in parallel, and

wherein the process symbol conversion unit is further configured to convert, based on the setting by the parallel process setting unit, the process symbol into a job to be simultaneously executed in parallel with the second process.

5. The operation command generation device according to claim 1,

wherein the protocol chart further comprises an area symbol arranged so as to be associated with the process symbol,

wherein the operation command generation device further comprises a work area setting unit configured to set a work area in which the process represented by the process symbol is to be executed, and

wherein the process symbol conversion unit is further configured to convert, based on the setting by the work area setting unit, the process symbol into a job to be executed in the work area.

6. The operation command generation device according to claim 1,

wherein the protocol chart further comprises a repetition line arranged so as to be associated with the process symbol,

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wherein the operation command generation device further comprises a repetition setting unit configured to set a number of repetitions of the process symbol, and

wherein the process symbol conversion unit is further configured to convert the process symbol into a job to be repeated as many times as the number of repetitions.

7. The operation command generation device according to claim 1,

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wherein the protocol chart further comprises a final symbol representing a final state of the container, and

wherein the operation command generation device further comprises a final symbol conversion unit configured to convert the final symbol into a job of executing a final process for the container.

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8. The operation command generation device according to claim 1, further comprising an execution time calculation unit configured to calculate a time required for execution of the job generated based on the protocol chart.

9. A non-transitory computer-readable storage medium storing a computer program for causing a computer to function as the operation command generation device of claim 1.

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10. The operation command generation device according to claim 1, further comprising a process symbol position specification unit configured to specify at least two process symbols equal to each other in the arrangement position in the first direction out of the plurality of process symbols,

wherein the execution order determination unit is further configured to determine an execution order of the at least two process symbols specified by the process symbol position specification unit based on the arrangement positions of the at least two process symbols in the second direction intersecting the first direction.

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11. The operation command generation device according to claim 10,

wherein the protocol chart further comprises a consecutive process symbol arranged so as to be associated with a plurality of process symbols,

wherein the operation command generation device further comprises a consecutive process setting unit configured to set consecutive execution of processes represented by the plurality of process symbols, and

wherein the process symbol conversion unit is further configured to convert, based on the setting by the consecutive process setting unit, the plurality of process symbols into jobs to be consecutively executed for a single container.

12. The operation command generation device according to claim 1,

wherein the protocol chart further comprises a transfer symbol representing a transfer process of transferring the process subject from a first container to a second container, and

wherein the operation command generation device further comprises a transfer symbol conversion unit configured to convert the transfer symbol into a job of transferring the process subject from the first container to the second container.

13. The operation command generation device according to claim 12, further comprising a transfer rule setting unit configured to set a first transfer rule when a number of the first containers and a number of the second containers are equal to each other,

wherein the transfer symbol conversion unit is further configured to convert, based on the first transfer rule, the transfer symbol into a job of repeating a process of transferring the process subject from the first container to the second container in a one-to-one manner as many times as the number of the first containers.

14. The operation command generation device according to claim 12, further comprising a transfer rule setting unit configured to set a second transfer rule when a number of the first containers is at least two and the number of the second containers is one,

5 wherein the transfer symbol conversion unit is further configured to convert, based on the second transfer rule, the transfer symbol into a job of repeating a process of transferring the process subject from the first container to the second container for all the first containers.

15 15. The operation command generation device according to claim 12, further comprising a transfer rule setting unit configured to set a third transfer rule when a number of the first containers is one and a number of the second containers is at least two,

10 wherein the transfer symbol conversion unit is further configured to convert, based on the third transfer rule, the transfer symbol into a job of repeating a process of transferring the process subject from the first container to the second container for all the second containers.

15 16. The operation command generation device according to claim 12, further comprising a transfer rule setting unit configured to set a fourth transfer rule when a number of the first containers is at least two and a number of the second containers is at least two,

20 wherein the transfer symbol conversion unit is further configured to convert, based on the fourth transfer rule, the transfer symbol into a job of repeating a process of transferring the process subject from the first container to an intermediate container for all the first containers, and then repeating a process of transferring the process subject from the intermediate container to the second container for all the second containers.

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17. The operation command generation device according to claim 12, further comprising a transfer rule setting unit configured to set a fifth transfer rule when a number of the first containers is at least two, a number of the second containers is at least two, and the number of the second containers is n times as many as the number of the first containers, where n is an integer,

wherein the transfer symbol conversion unit is further configured to convert, based on the fifth transfer rule, the transfer symbol into a job of repeating a process of transferring the process subject from a single first container to n second containers for all the first containers and all the second containers.

18. The operation command generation device according to claim 12, further comprising a transfer rule setting unit configured to set a sixth transfer rule when a number of the first containers is at least two, a number of the second containers is at least two, and the number of the first containers is n times as many as the number of the second containers, where n is an integer,

wherein the transfer symbol conversion unit is further configured to convert, based on the sixth transfer rule, the transfer symbol into a job of repeating a process of transferring the process subject from n first containers to a single second container for all the first containers and all the second containers.

19. The operation command generation device according to claim 12, further comprising a transfer rule setting unit configured to set a seventh transfer rule when a number of the first containers is at least two and a number of the second containers is at least two,

wherein the transfer symbol conversion unit is further configured to convert, based on the seventh transfer rule, the transfer symbol into a job of repeating a process of transferring the process subject from a single first container to all the second containers for all the first containers.

20. An operation command generation method, comprising:

determining, based on respective arrangement positions of a plurality of process symbols each representing a process for a process subject on a protocol chart comprising the plurality of process symbols, an execution order of the plurality of process symbols; and

respectively converting the plurality of process symbols to jobs for a process system comprising at least a robot so that processes represented by the plurality of process symbols are executed in the execution order determined in the determining of the execution order,

wherein the protocol chart further comprises an initial symbol with which at least one process symbol is associated, the initial symbol representing a container for the process subject,

wherein some of the process symbols are arranged along a first direction from the initial symbol,

wherein another initial symbol is arranged being separate from the initial symbol in a second direction intersecting the first direction, and the former initial symbol and the latter initial symbol represent different containers, and

wherein the execution order of the processes represented by the process symbols arranged at equal position in the first direction is determined according to their position in the second direction.

21. A process system, comprising:

the operation command generation device of claim 1;

a robot controller configured to control a control subject based on an operation command generated by the operation command generation device; and

a robot configured to carry out a process on a process subject, the robot being controlled by the robot controller.