ITA_User_Instruction_Manual

Terraform-CLI-driver

― Version 1.11 ―

Disclaimer

Trademark

※”Exastro IT Automation” is written as “ITA” in this document.

Table of Contents

Introduction

This document explains ITA’s functions how and how to operate them.

1 Terraform driver overview

This chapter describes Terraform and Terraform driver.

1.1 Terraform

Terraform is an orchestration tool that optimizes infrastructures provided by HashiCorp.

Infrastructure configurations coded in HCL language (HashiCorp Configuration Language) generates an execution plan and then runs the construction.

The Terraform-CLI-driver installs the Terraform CLI package provided by HashiCorp to the same server where the user's ITA is located and uses it.

For more information about Terraform, please refer to the Terraform product manual.

1.2 Terraform-CLI-driver

The Terraform-CLI-driver functions as an option for ITA systems, allowing Terraform installed to ITA systems to execute operations (Plan/PolicyCheck/Apply) and acquire operation logs.
Users can manage module files used to execute operations (Plan/Apply) as parts in ITA, so that they can be re-used.

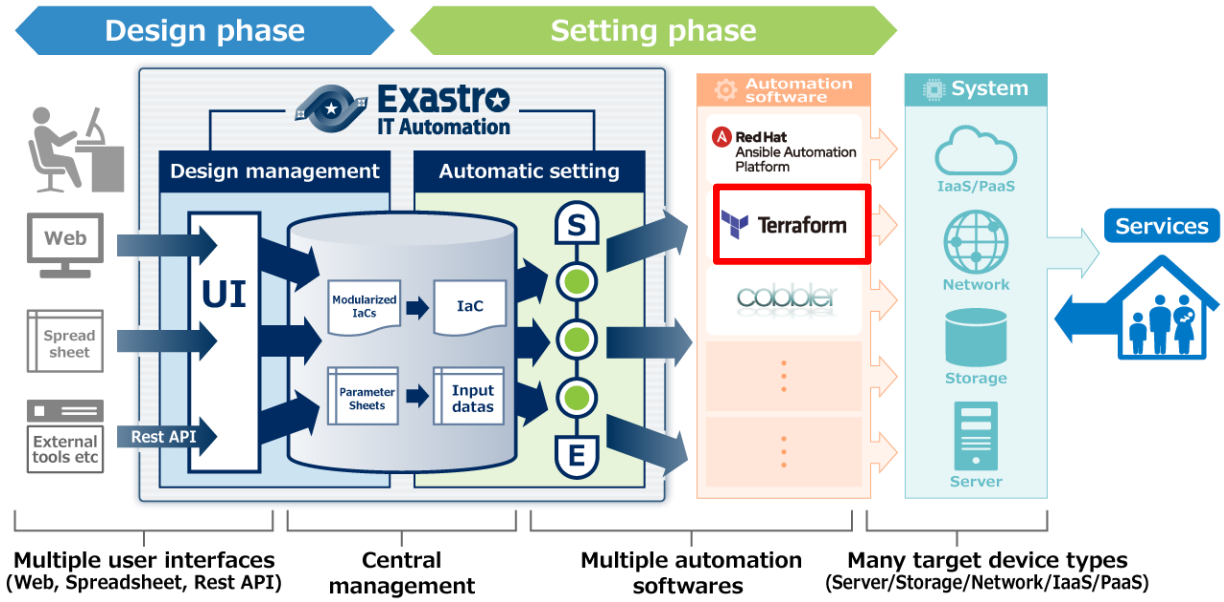


Figure 1.2-1 ITA System Overview

Additionaly, the Terraform-CLI-driver can set variables in Modules from the screen.For details, please refer to Chapter "2. Handling variables with Terraform-CLI-driver" in this document.

2 Handling variables with Terraform-CLI-driver

2.1 Variable type

In the Terraform-CLI-driver, users can set specific variable values in Modules from the ITA configuration screen.

※For more information on the configuring method, please refer to chapter "5.2.8Substitution value list“

There is one module variable type that can be handled as an ITA variable.

Type	Content

Normal variable	A variable that allows you to define one specific value for the variable name.
	The variables in the Module should be written in the following format according to the variable rules of the HCL (HashiCorp Configuration Language). In this case, "xxx" is extracted from the Module file as a variable.
	Users can also set type and default values. In the example below “○○” and “△△”are extracted as “type” and “default”
	type and default configuration is not required.
	variable “xxx” {
	type = ○○
	default = △△
	~Abbr~
	}

2.2 Extraction of variables and registration of specific values

User can register specific values by extrating variables out from module files uploaded to ITA.

The specific values of the extracted variables are registered in “5.2.8 Substitution value list”.
The registered variables and specific values are written in the terraform.tfvars file generated when the operation is run. In the file, “Variable name” is written as ”Key”, and “Specific value” as “Value”.

2.3 Variable types

The Type of a variable can be configured within the variable.

When describing variables within Modules, make sure to follow the HCL (HashiCorp Configuration Language) variable rules.The variables handled in ITA are as follows:

For examples on how to describe them, please see" 8.1 Module file input example/ register example"

type	Detailed description	Input order Target ※1	Member variable Target※2	Type description	Default description
string	Character string。	×	×	string	ABC
number	Numeric value	×	×	number	2022
bool	True or false	×	×	bool	true
list	Array type	○	×	list(string)	["A", "B", "C"]
set	Array type. A unique value configuration is required.The specific value will not be checked if it is unique or not by ITA.	○	×	set(number)	[1, 2, 3]
tuple	Array type. The user must decide which type is which number in advance. The number of input values is already determined, so they can be selected as member variables from a pulldown menu on ITA.	×	○	tuple([string, number])	["ABC", 2022]
map	Key-value type. If there a type that contains more than one map type configured on ITA, the user will not be able to specify KEY value from the type information. It is therefore important that you make sure that the HCL SETTINGS are set to ON if the user plans to configure substitute values. For more information regarding HCL settings,	×	×	map(string)	{ "key" = "value" }

	please see Chapter “5.2.7 Substitution value automatic registration” or “5.2.8 Substitution value list”				

object	key-value type。
	ITA handles keys as Member variables. Do not include japanese characters in the key name.
		×	○	object({
				key = number
				})
					{
					“key” = 2022
					}

any	Type that fits all. Handled the same as string type on ITA.	×	×	any	ABC
No description	If no "type" is described, it will be handled the same as a string type.	×	×		ABC

※1…Substitute order
The substitute order is the order of which specific values are set to variables (starting from top).
If the variable type (or the type for the lowest variable in a hierarchy configuration) is "list" or "set", they can be configured in the Substitute value auto registration settings menu/Substitute value list menu.

Example：For “list” type variables
・tf file and registration values

```
variable "VAR_hoge" {
      type = list(string)
}
```

1． Substitute value example（Substitute value auto registration settings/Substitute value list）

Item No.	Variable name	Member variable	Substitute order	Specific value
1	VAR_hoge	No input required	1	ABC
2	VAR_hoge	No input required	2	DEF

2. Value sent to Terraform

```
[“ABC”, “DEF”]
```

Example: If the type of the variable at the lowest level of the variable hierarchy is "set"

・tf file and registration value

```
variable "VAR_hoge" {
      type = object({
            key = set(number)
      })
}
```

1. Substitute value example（Substitute value auto registration settings/Substitute value list）

Item No.	Variable name	Member variable	Substitute order	Specific value
1	VAR_hoge	key	1	1
2	VAR_hoge	key	2	2

2. Value sent to Terraform

```
{
      key = [1, 2]
}
```

※2…Member variable
Member variable is the key name if the variable type is "key-value". If the variable type is "object", the Member variable is "<KEY> = <TYPE>の<KEY>"
If the variable type is tuple, the Member variable is the numbered variables defined in the tuple (Numbered [0], [1], [2]...).
If the variable type is a registration target in the Nested variable list menu, the variable is numbered [0],[1],[2]... based on the maximum number of repetitions and is designated as Member variable.
For more information regarding Variable nests, please see Chapter “5.2.6 Nested variable list".

Example：If the variable type is “object”
・tf file and registration value

```
variable "VAR_hoge" {
    type = object({
        NAME = string,
        IP = string
    })
    default = {
        “NAME” = “machine_01”,
        “IP” = “127.0.0.1”
    }
}
```

1． Substitute value example（Substitute value auto registration settings/Substitute value list）

Item No.	Variable name	Member variable	Substitute order	Specific value
1	VAR_hoge	NAME	No input required	my_machine
2	VAR_hoge	IP	No input required	192.168.0.1

2．Value sent to Terraform

```
{
    NAME = “my_machine”,
    IP = “192.168.0.1”
}
```

Example：If the variable type is “tuple”.
・tf file and registration value

```
variable "VAR_hoge" {
      type = tuple([string, number])
      default = [“aaa”, 2022]
}
```

2． Susbtitute value example（Substitute value auto registration settings/Substitute value list）

Item No.	Variable name	Member variable	Substitute order	Specific value
1	VAR_hoge	[0]	No input required	bbb
2	VAR_hoge	[1]	No input required	2023

2．Value sent to Terraform

```
[“bbb”, 2023:
```

Example：If the variable type is target for Nested variable list.
・tf file and registration value

```
variable "VAR_hoge" {
      type = list(set(string))
      default = [
            [“aaa”, “bbb”],
            [“ccc”, “ddd”]
      ]
}
```

1． Susbtitute value example（Substitute value auto registration settings/Substitute value list）

Item No.	Variable name	Member variable	Substitute order	Specific value
1	VAR_hoge	[0]	1	AAA
2	VAR_hoge	[0]	2	BBB
3	VAR_hoge	[1]	1	CCC
4	VAR_hoge	[1]	2	DDD

2．Value sent to Terraform

```
[
      [“AAA”, “BBB”],
      [ “CCC”, “DDD”]
]
```

3 Terraform driver console menu structure

This chapter explains the ITA Console's menu configuration.

3.1 Menu / screen list

① ITA Basic console menu

The list ITA Basic console menus used by the Terraform-CLI-driver is as shown below.

Table 3.1-1 Basic console menu/screen list

No	Menu group	Menu / Page	Description
1	ITA Basic console	Input operation list	Allows the user to maintain (view/register/update/abolish) the Operation list.

② **Terraform-CLI-driver console menu**

The menus in the Terraform-CLI-driver menu are as shown below.

Table 3.1-2Terraform-CLI-driver console menu list.

No	Menu group	Menu/ Page	Hidden menu※1	Description
1	Terraform	Interface information		Manages executed operation information.
2		Workspaces management		Manages Information of Workspaces used in Terraform.
3		Movement list		Manages a list of Movement that can be registered to the Symphony menu.
4		Module file collection		Manages Module files.
5		Movement-Module link		Manages links between Movement and Module files.
6		Nested variable list		Manages the maximum number of iterations of the member variables if the Variable type defined in the tf file registered in the Module file collection is "list" or "set" and "list", "set","tuple" or "object" is defined within said variables.
7		Substitution value automatic registration		Manages movements and variables that link items and values per operation registered in the parameter sheet menu.
8		Substitution value list		Manages the substitute values of the variables.
9		Operation execution		Allows the user to select and execute Movement and Operations.

10		Operation status		Displays the status of executed operations.
11		Operation list		Manages executed operation history.
12		Module variable link list	○	Manages links between Module variables and Module files.
13		Member variable list	○	Manages member variables.
14		Movement variable link list	○	Manages links between Movements and Variable names.

※1 Hidden menus are used to register and update data using the backyard function.
They are set to be hidden when the Terraform-CLI-driver is installed.
If you want to display the hidden menus, you can do so from the “Management console > Role/Menu link list” menu. For more information, please see the Management console user manual.

Note that the backyard function might not function normally if the data in the hidden menus have been changed. We recommend not changing any of the data.

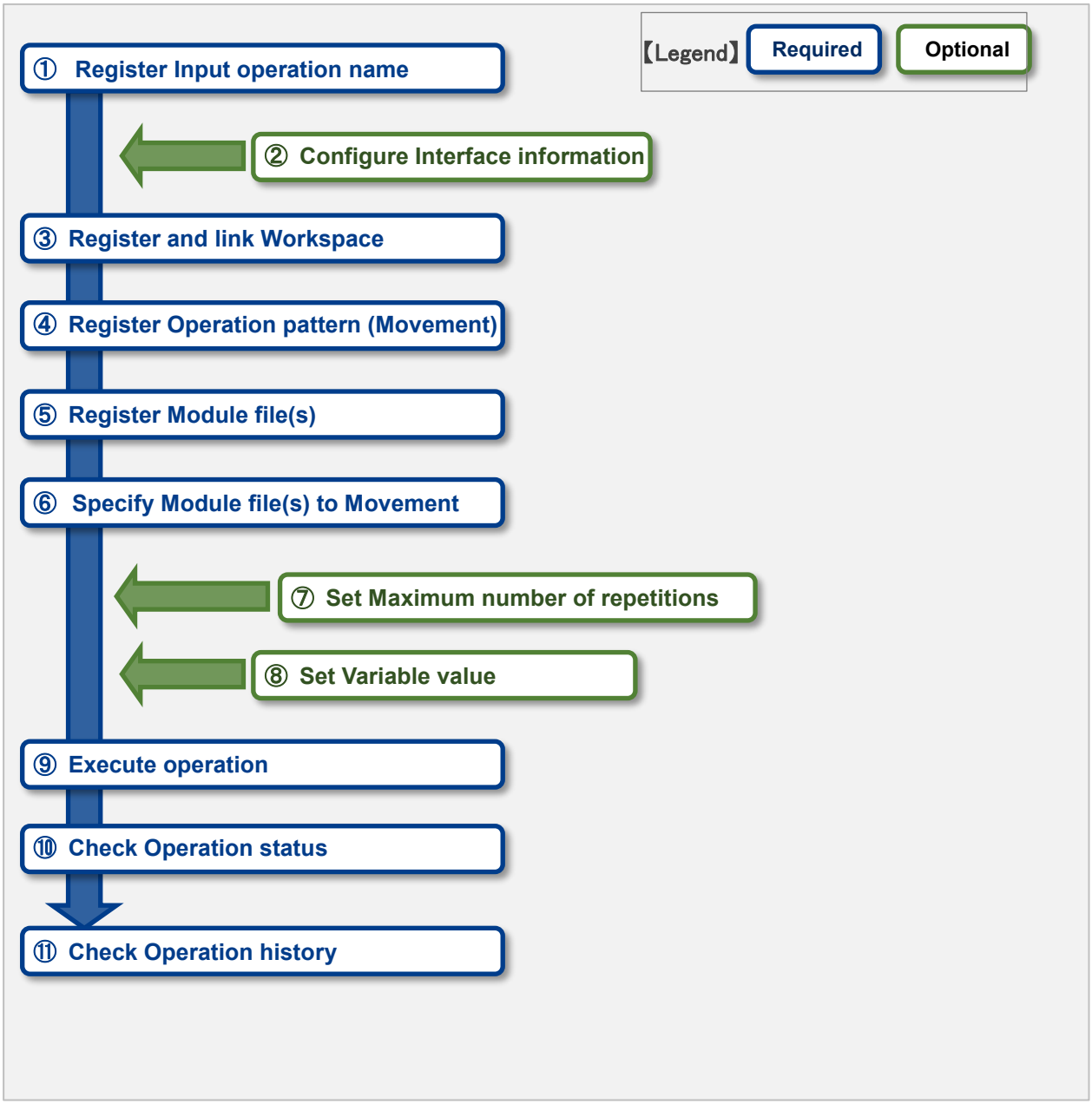
4 Terraform-CLI-driver workflow

This section explains the workflow for each of the Terraform consoles.

4.1 Terraform workflow

The standard work flow for each Terraform console is as follows.
Details of each operations are described in the next section.
For information on how to use the ITA Basic Console, please refer to "User Instruction Manual_Basic Console".

The flow to operation in Terraform are as follows.



● Work flow details and references

① Register Input Operation name

Register an input operation name from the ITA Console's Operation list screen.
For details, refer to “5.1.1 Operation list”.

② Register interface information

Register the interface information for the Terraform that links with ITA.
For details, refer to “5.2.1 Interface information”.

③ Register and link Workspace.

Register Workspace information and link with Terraform.
For details, refer to “5.2.2 Workspaces list”.

④ Register operation pattern (Movement)

Register a movement.
For details, refer to “5.2.3 Movement list”.

⑤ Register module files

Register a Module file to be executed in the operation.
For details, refer to “5.2.4 Module files”.

⑥ Set module files in Movement

Specify the Module files in the registered Movement.
For details, refer to "5.2.5 Movement module link".

⑦ Set Maximum number of repetitions

Set the maximum number of repetitions for the member variables.
For details, refer to "5.2.6 Nested variable list".

⑧ Set variable value (Execute if needed)

Set the value of the variable(s) defined in the Module files registered in the corresponding Movements. The variable values does not need to be registered if variables are not being used.
For details, refer to "5.2.7 Substitution value automatic registration".

⑨ Execution

Select and set the execution date and time, and the Operation to indicate the execution of the operation.
For details, refer to "5.2.8 Substitution value list".

⑩ Check operation status

The status of the work executed is displayed in real time.
User can also monitor work emergency stops, execution logs and error logs.
For details, refer to "5.2.9 Execution".

⑪ Check operation history

A list of the work executed is displayed and the history can be checked.
For details, refer to "5.2.10 Check operation status".

5 Terraform driver function and operation method explanation

This document explains each console function used in Terraform driver.

5.1 Basic console

This section explains a part of the ITA Basic Console.
Please refer to the ITA basic console Manual while operating the ITA Basic console.

5.1.1 **Operation list**

(1) The "Operation list" screen manages the operations on the target host that the Orchestrator executes. Select the work from the menu in the ITA basic console.

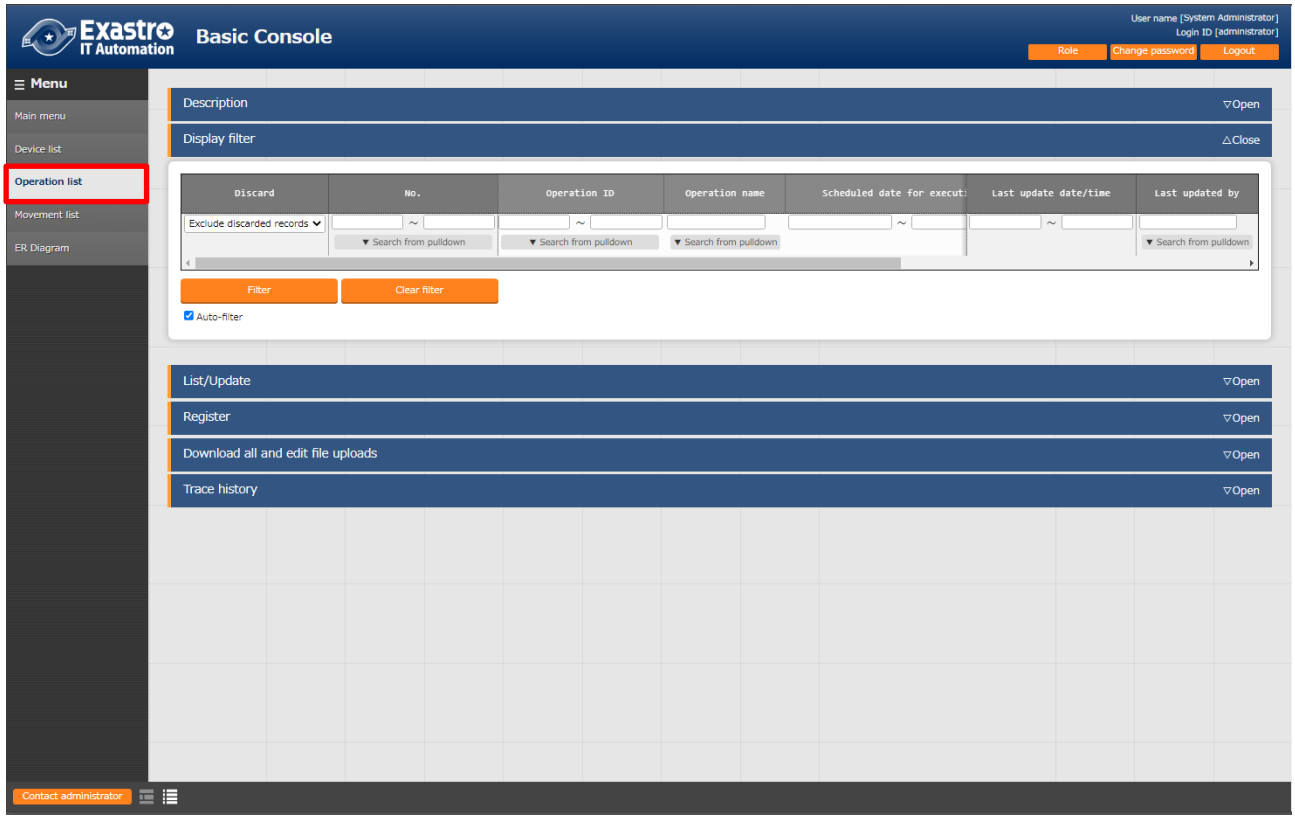


Figure 5.1.1-1 Submenu screen (Operation list)

For more information on how to register operations, please refer to "User Instruction Manual_Basic Console"

5.2 Terraform-CLI-driver console

This section describes the operation on the Terraform console.

5.2.1 **Interface information**

(1) In the “Interface Information” menu, users can maintain (view/update) information of the Terraform linked with the ITA system.

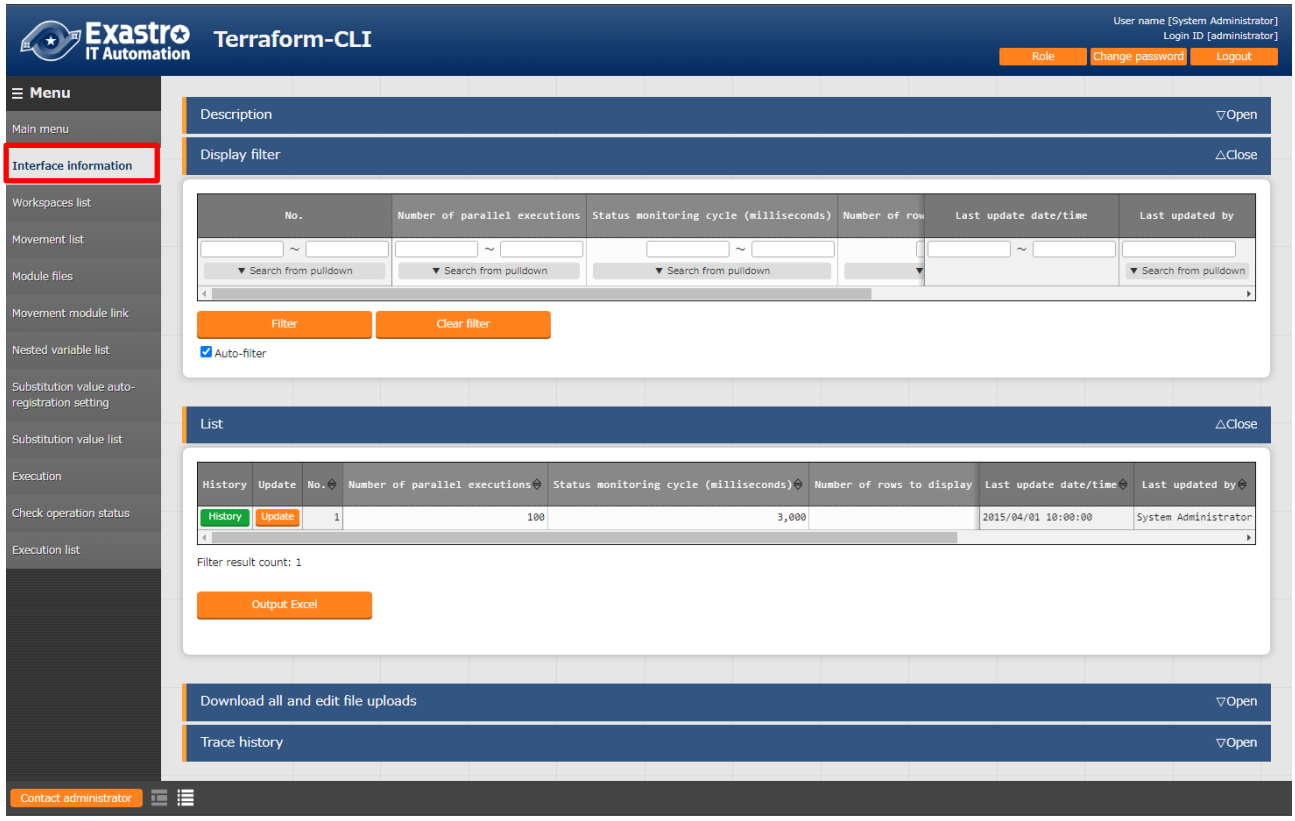


Figure 5.2.1–1 Submenu screen (Interface Information)

(2) Click the "List" button and then "Update" button to register Interface information.
If an operation is executed without registered interface information or with multiple records registered to it, the operation will meet an unexpected error when executed.

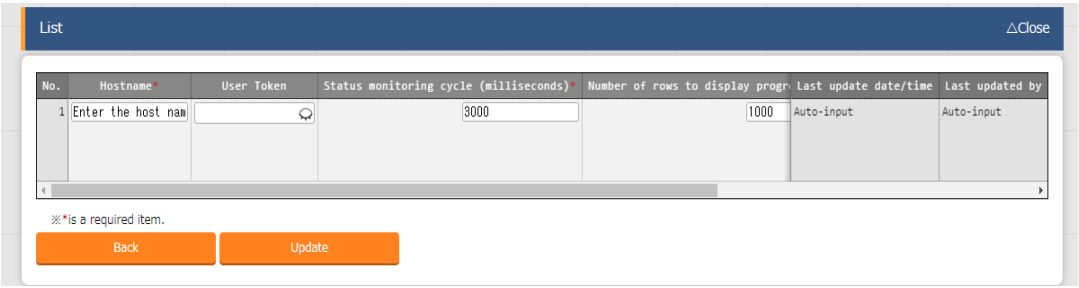


Figure 5.2.1-2 Registration screen (Interface Information)

(3) The list of items on the interface information screen is as follows.

Table 5.2.1-1 Item list（interface information）

Item	Description	Input required	Input type	Restriction
Number of parallel executions	Input the maximum amount of how many Movements (Terraform-CLI) that can be executed at the same time.	○	Manual input	
Condition observation period (Unit milli second)	Enter the refresh space for the log displayed in "5.2.10 Check operation status". Usally, about 3000 milliseconds is the recommended value.	○	Manual input	Minimum value 1000 ms
Number of lines progress status displayed	Enter the maximum number of lines displayed in the progress log and error log in "5.2.10 Check operation status".Recommended value is 1000 lines.	○	Manual input	-
NULL link	If the specific value of the parameter sheet in the " Substitution value auto-registration settings" menu is NULL(blank), users can set registrations to the list to have the value NULL(blank) or not. This value is applied when "NULL Link" (In the Substitution value auto-registration setting menu) is blank. ・ If "Enable", any value in the parameter sheet is registered in the substitution value list. ・ If "Disable", the value is registered in the value list only if the parameter sheet contains a value.	○	List selection	
Remarks	Free description field.	-	Manual input	Maximum length 4000 bytes

5.2.2 **Workspaces list**

(1) In the “Workspaces list”, users can maintain (view/register/update/abolish/delete resources) Workspaces used by Terraform.
Workspaces are used as directories for running Terraform commands.
When running operations on the same Workspace, the state files generated by Terraform are managed on a Workspace-by-Workspace basis to maintain power equality.

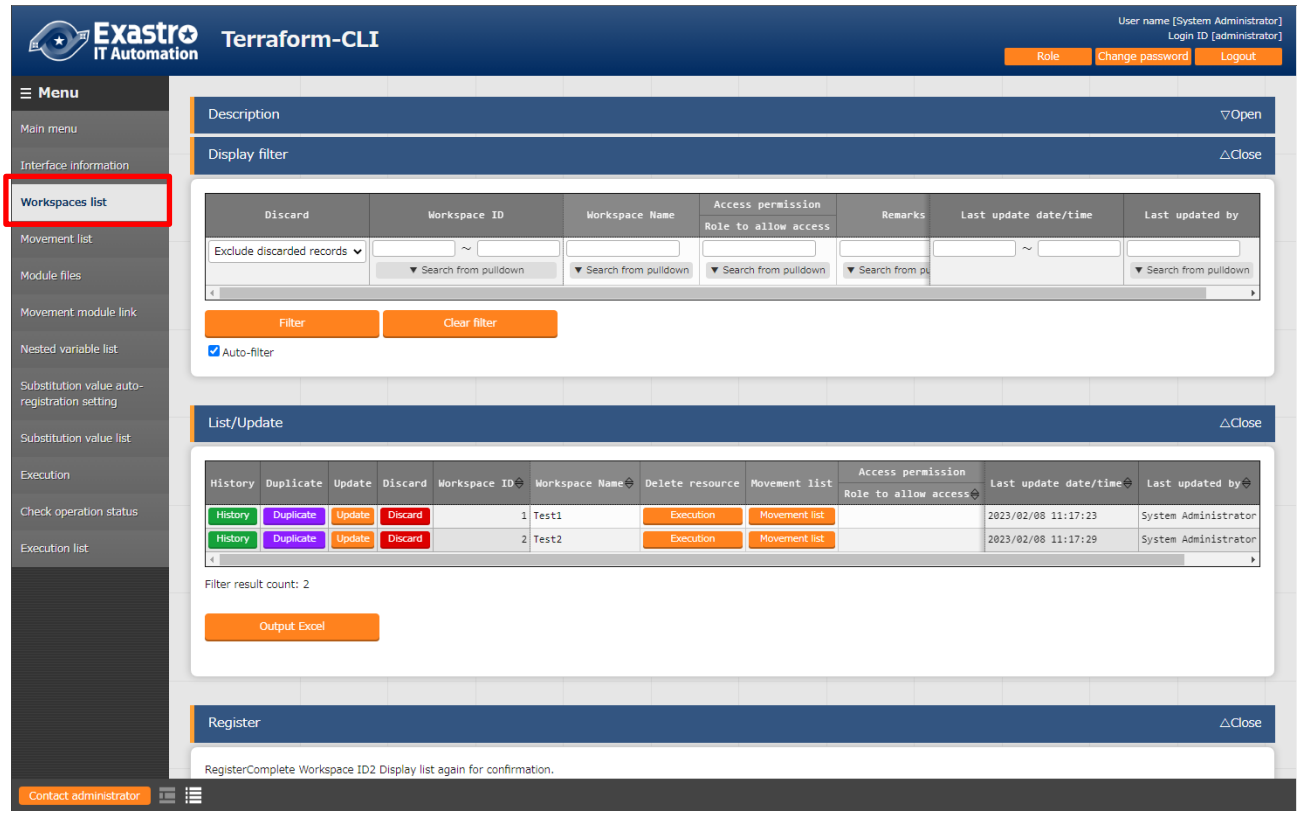


Figure 5.2.22-1 Submenu screen（Workspaces list）

(2) Click the "Register" → "Start registration" button to register Workspace information.

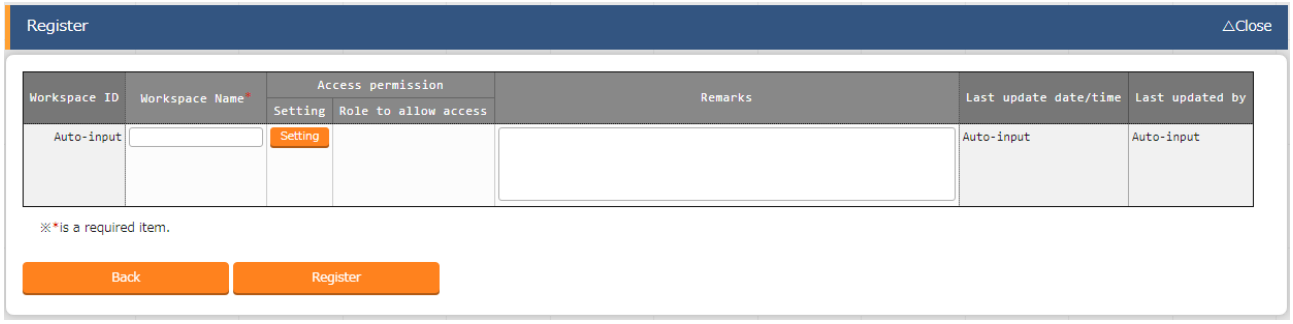


Figure 5.2.22-2 Registration screen（Workspaces list）

(3) Clicking the “Delete resources” button deletes (Terraform Destroy) the target Workspace’s resources.
Clicking the “Movement list” button moves the user to the target Workspace’s “5.2.3 Movement list”

Figure 5.2.22-3 Terraform link (Workspaces List)

(4) The items in the Workspaces list screen is as follows.

Table 5.2.22-1 item list（Workspaces list）

Item	Description	Input required	Input type	Restriction
Workspace Name	Enter the name of the Workspace name. Alphanumeric characters and symbols (_ ,-) only (underbars and hyphens) are available.	○	Manual input	Maximum length 90 bytes
Delete Resources	This button deletes the target Workspace's configurated/managed resources.Clicking the button will display a dialog box asking the user to confirm. Pressing "OK" will move the user to "5.2.10 Check operation status" where the Workspace's configurated/managed resources are deleted.	-	-	
Movement list	This button moves the user to "6.2.4 Movement list"	-	-	
Remarks	Free description field.	-	Manual input	Maximum length 4000 bytes

5.2.3 **Movement list**

(1) In “Movement list” users can maintain (browsing/registration/update/abolition) Movement names.
Since Movements needs to be linked to the Workspace as Terraform information, the target needs to be registered in “5.2.2 Workspaces list”.

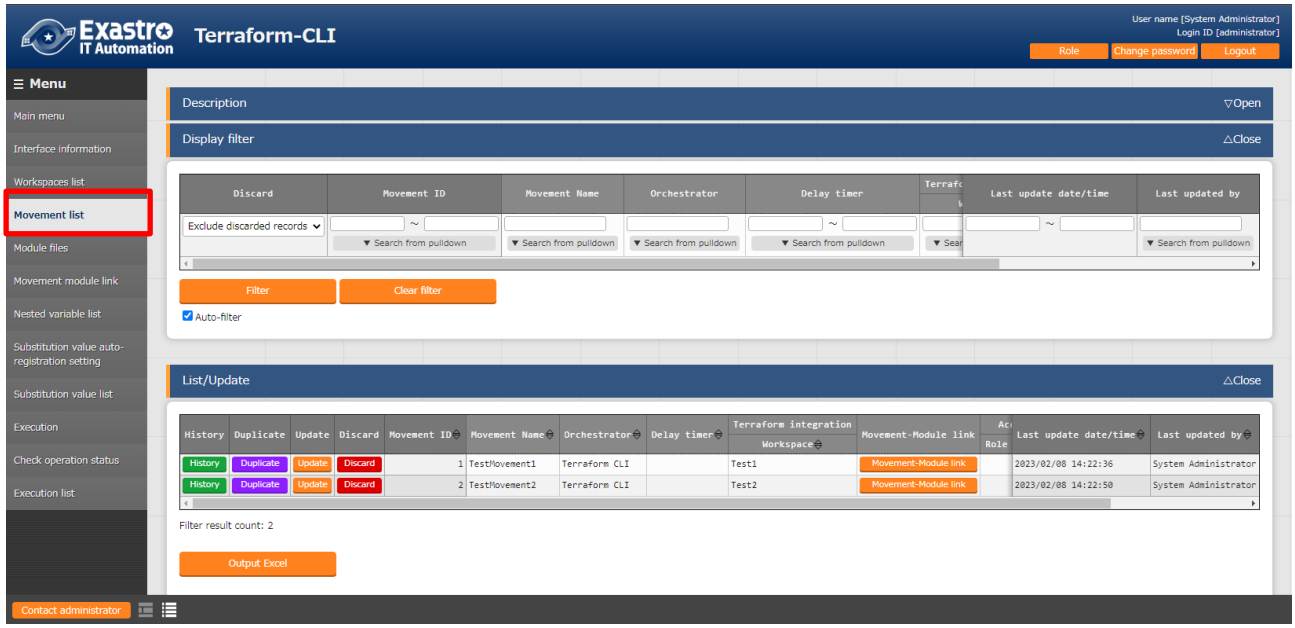


Figure 5.2.33.1 Submenu screen (Movement list)

(2) Click the "Register" → "Start registration" button to register Movement information.

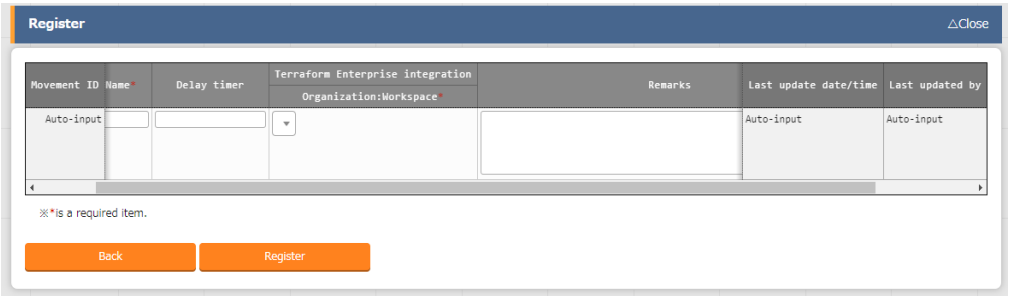
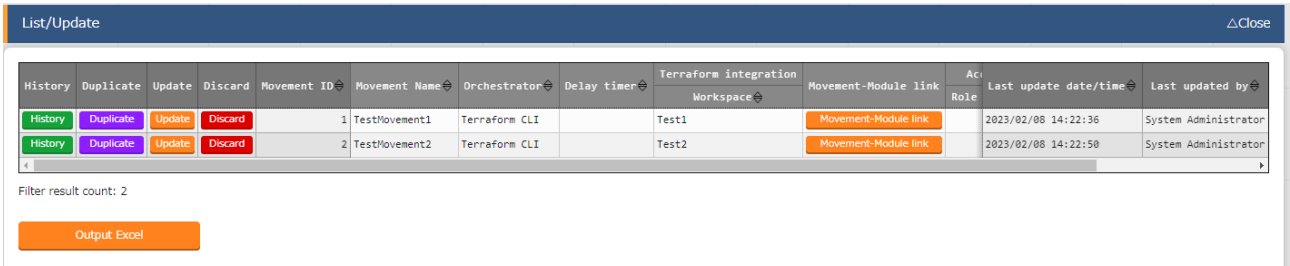


Figure 5.2.33-2 Registration screen (Movement list)

(3)



Clicking the Movement-Module link button will move the user to the target Movement's “5.2.5Movement module link”

Figure 5.2.33-3 Submenu screen (Movement list)

(4) The items in the Movement list screen are as follows.

Table 5.2.3-1 Item list（Movement list）

Item		Description	Input required	Input type	Restriction
Movement Name		Enter a name for the Movement.	○	Manual input	Maximum length 256 bytes
Orchestrator		"Terraform" is automatically entered.	-	-	-
Delay timer		Enter the specified period (1~) if you want the status to be displayed as a warning when the movement is delayed for the specified period. (Unit: minutes) If it is not entered, no warning will be displayed.	-	Manual input	-
Terraform use information	Organization: Workspace	Select the Workspace registered (linked to Organization) in "5.2.2Workspaces list".	○	List selection	
Movement-Module link		Moves the user to “5.2.5Movement module link”.	-	-	
Remarks		Free description field.	-	Manual input	Maximum length 4000 bytes

5.2.4 **Module files**

(1) In the “Module files” menu, users can maintenan (browsing/registration/update/abolition) user created module files.
For more information regarding Module description, refer to " 6.1 Module description.

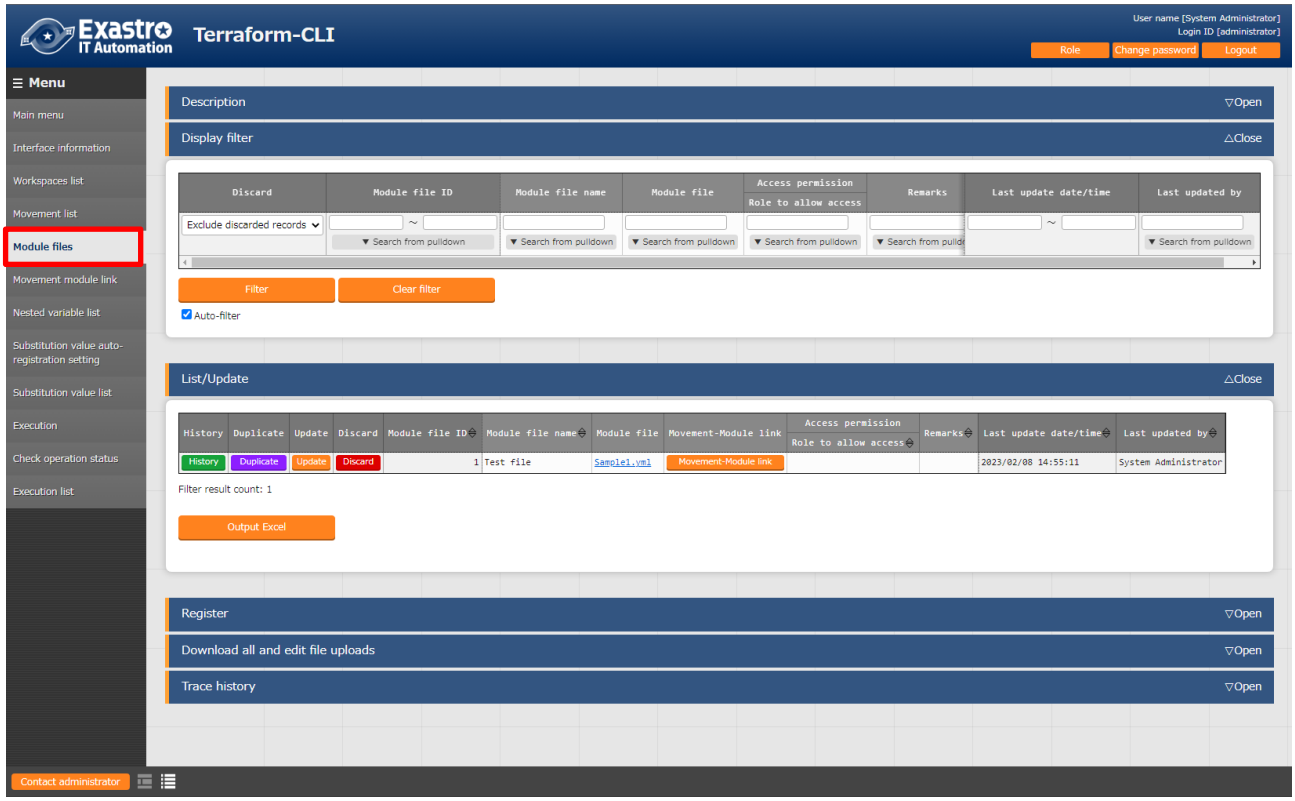


Figure 5.2.44-1 Submenu screen (Module files)

(2) Click the "Register" → "Start registration" button to register Module information.

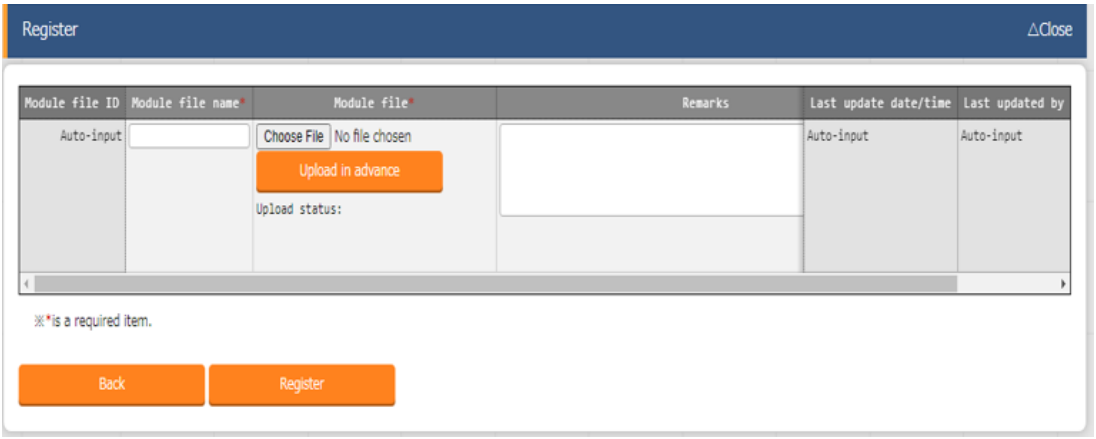
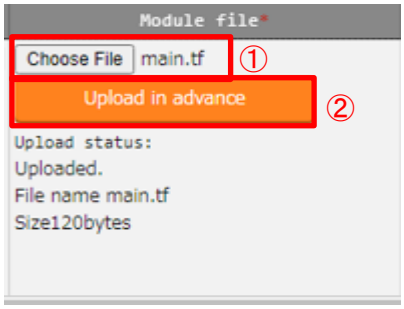


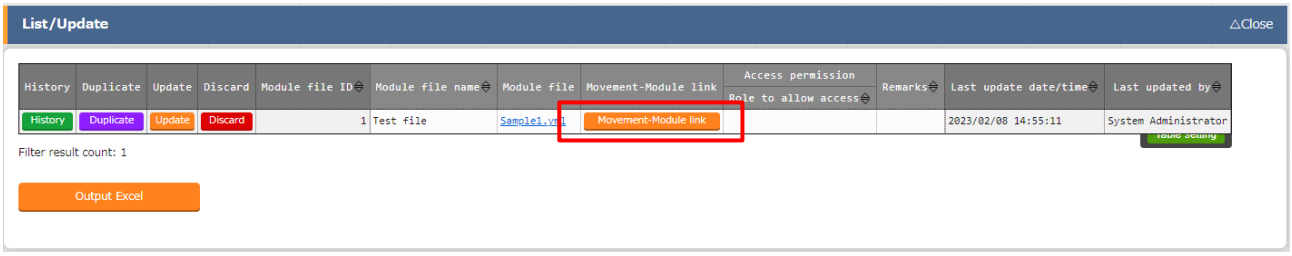
Figure 5.2.44-2 Registration screen (Module files)

Make sure to press the “Upload in advance” button (①) before registering the files to ITA. Confirm that the file name displayed (②) is correct and press the “Register” button.



(3) Clicking the Movement-Module link button will move the user to the target Movement’s “5.2.5 Movement module link”.

Figure 5.2.44-2 Submenu screen (Module files)



(4) The items found in the Module files menu are as follows.

Table 5.2.44-2 Item list (Module files)

Item	Description	Input required	Input type	restriction
Module files name	Enter a name for the Module file. This is the name that will be used for the Module file in ITA.	○	Manual input	Maximum length 256 bytes
Module files	Upload the created Module files.	○	File selection	Maximum size 4G bytes
Movement-Module link	Moves the user to “6.2.10 Movement-Module link”			
Remarks	Free description field.	-	Manual input	Maximum length 4000 bytes

(1) The variables defined in the Module files are extracted by a BackYard process.
The extracted variables can then have specific values registered to them in menus such as “5.2.7 Substitution value automatic registration” and “5.2.8 Substitution value list”.

Note that the extraction does not happen in real time, meaning it make take some time before they can be used as variables in menus such as

※1 For more information regarding when the extraction happens, please see “③Change the startup period” under ” 7.2 Maintenance and Maintaining”

5.2.5 **Movement module link**

(1) In “Movement module link”, performs maintence (browsing/register/update/ abolition) of the module files executed in the Movement.
Multiple Module files can be linked to the Movement.

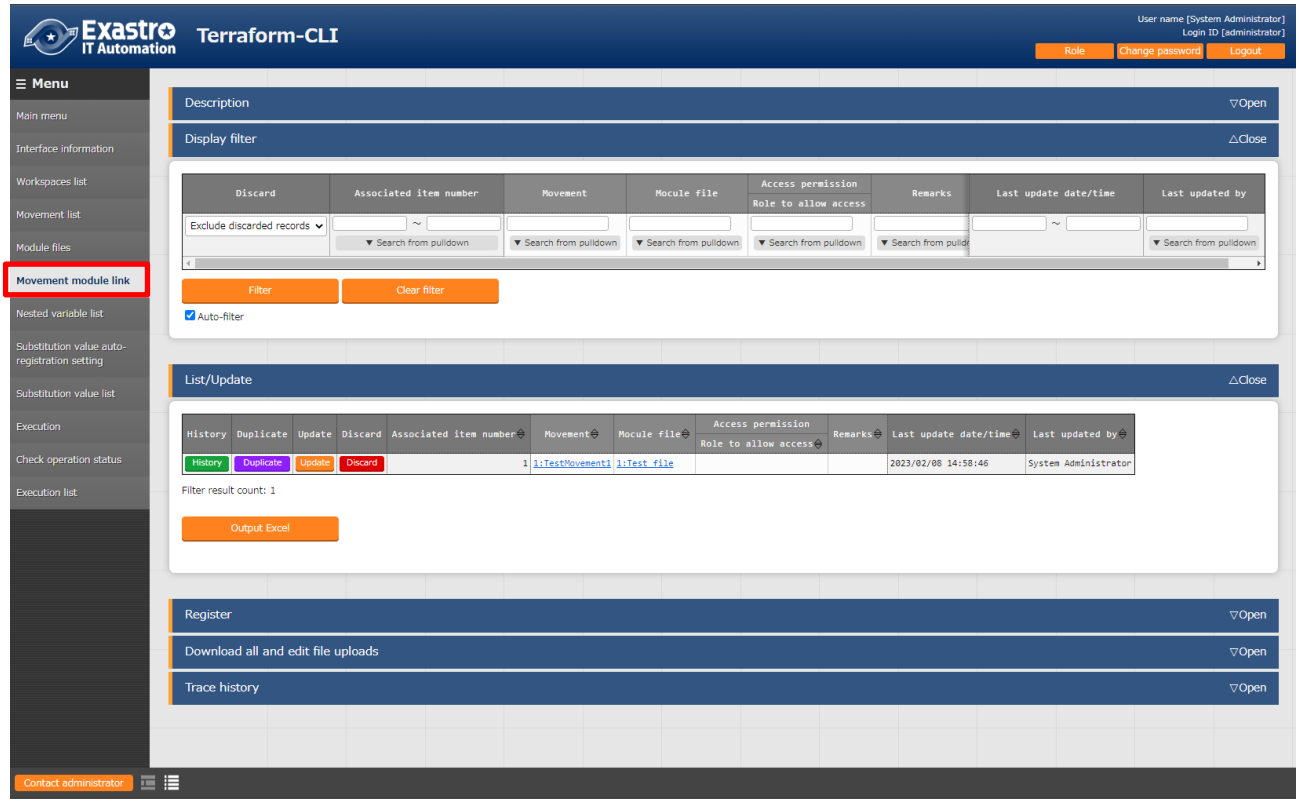


Figure 5.2.55-1 Submenu screen（Movement module link）

(2) Click the "Register" → "Start registration" button to register Movement Module information.

Figure 5.2.55-2 Registration screen（Movement module link）

(3) Clicking the Movement URL will move the user to “5.2.3 Movement list”.
Clicking the Module file URL will move the user to “5.2.4 Module files”.

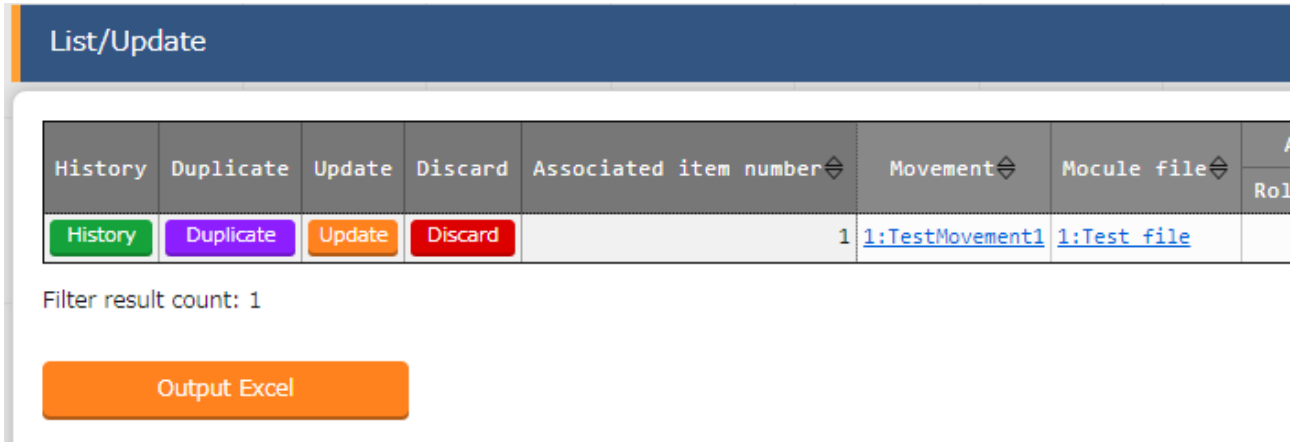


Figure 5.2.55-3 Sunmenu screen（Movement module link）

(4) The item list of Movement module link is as follows

Table 5.2.55-1 Item list（Movement module link）

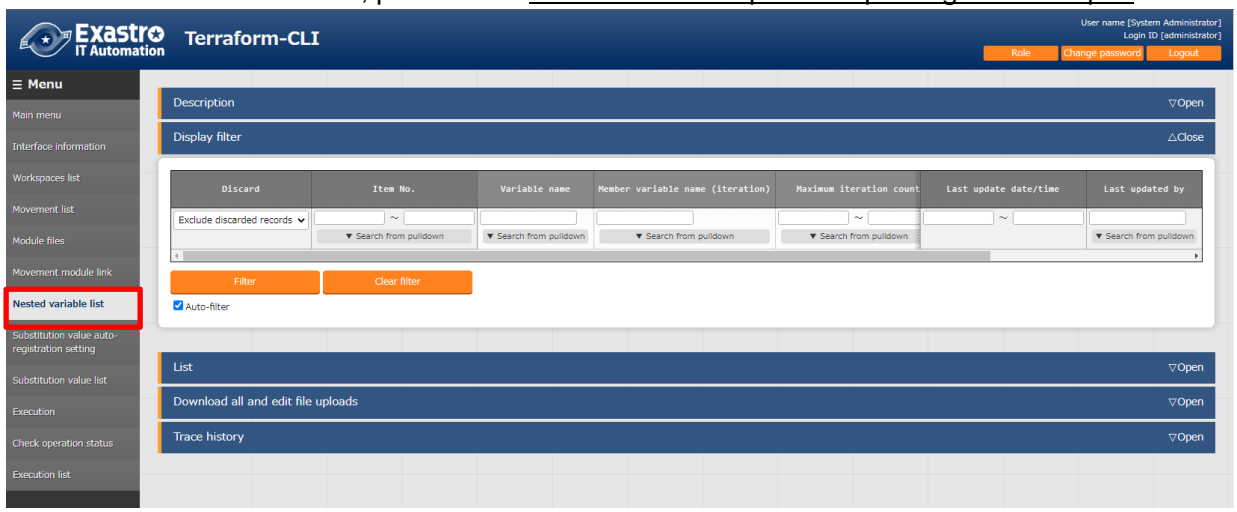
Item	Description	Input required	Input type	Restriction
Movement	Select a Movement registered in "5.2.3 Movement list".	○	List selection	-
Module files	Select a Module file registered in "5.2.4 Module files".	○	List selection	-
Remarks	Free description field.	-	Manual	Maximum length 4000 bytes

5.2.6 **Nested variable list**

(1) In the "Nested variable list" menu, users can view and change the maximum number of repetitions of the member variables if the Variable type defined in the tf file registered in the Module file collection is "list" or "set" and "list", "set","tuple" or "object" is defined within said variables.

Items in this menu cannot be registered, discarded or restored as BackYard manages the records based on the Module file collection.

For more information, please see "8.1 Module file input example/ register example".



For more information regarding the examples of flows with the Nested variable list, please see 8.2 Nested variable list flow example".

Module file and Nested variable list registration

・Module file（tf file） and registration value

```
variable "VAR_hoge" {
    type = list(
        object({
            IP = string,
            NAME = string
        })
    )
    default = [
        { “IP” = “127.0.0.1”, “NAME” = “machine_01” },
        { “IP” = “127.0.0.2”, “NAME” = “machine_02” }
    ]
}
```

・Nested variable list

Item No.	Variable name	Member variable	Maximum repetitions
1	VAR_hoge		2

Figure 5.2.66-1 Submenu screen（Nested variable list）

(2) Press the “List”>”Update” button to edit the maximum amount of repetitions.

Figure 5.2.66-2 Update screen（Nested variable list）

(3) The item list is as following

Figure 5.2.66-3 Item list（Nested variable list）

Item	Description	Input required	Input method	Restrictions
Variable name	Displays the variable(s) used in the file registered with the Movement-Module link.	-	No input required	
Member Variable name（With repetitions）	If the Nest variable list target is a Member variable, the Member variable name will be displayed. The Member variables are displayed concatenating with variables with "." for each stage.	-	No input required	
Maximum amount of repetitions	Input a number between 1 and 99,999,999. The initial value is set to the number obtained from the defauly value in the tf file. If there is not "default" in the tf file, the value "1" will be set. If it is not last updated by "Terraform variable update procedure", it is not possible to change the value from updating the Module file.	○	Manual input	Input value: 1～99,999,999
Remarks	Free description field	-	Manual input	Maximum length 4000 bytes

※Initial registrations and repetition updates are not happening in real-time, so it might take a couple of minutes before the variables can be used in "5.2.7 Substitution value automatic registration“ and "5.2.8 Substitution value list"
The chapter " 7.2 Maintenance and Maintaining" contains more information regarding the timing of when they are updated.

(4) Access permission role

The permission roles set for variable nesting management are set to the permission roles of the Module material collection in which the relevant variable is defined.

5.2.7 **Substitution value automatic registration**

(1) In "Substitution value automatic registration", users can link Parameter sheets created with the Menu creation tool (With Operation) and Movement variables.
The registered information will be reflected to the Substitution value list by the BackYard Process.
The reflection rules is mentioned in" 6.2BackYard Content (2)Automatic Substitute Value Registration Settings".

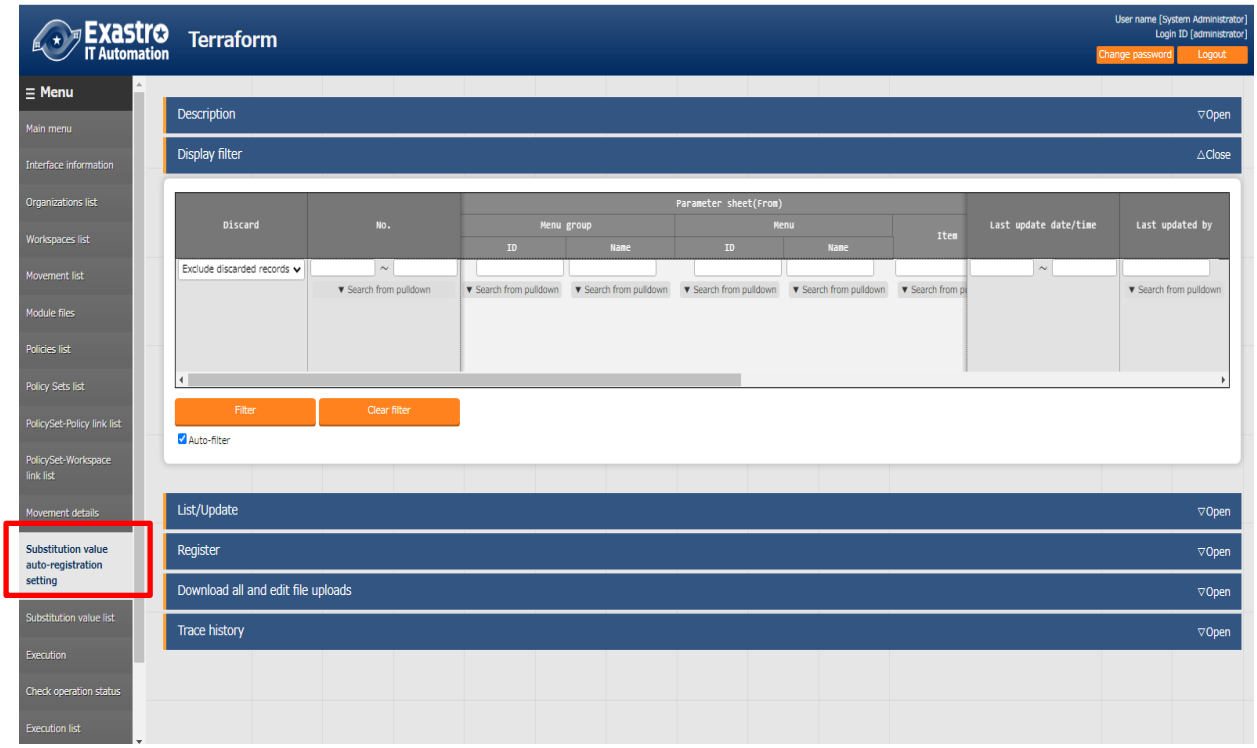


Figure 6.2.11-1 Sub-menu screen (Substitution value automatic registration)

(2) Click the "Register" → "Start registration" button to register Substitute value infornation.

Figure 6.2.11-2 Registration Screen (Substitution value automatic registration)

(3) Clicking the Menu ID or the Menu name link will move the user to the target menu.

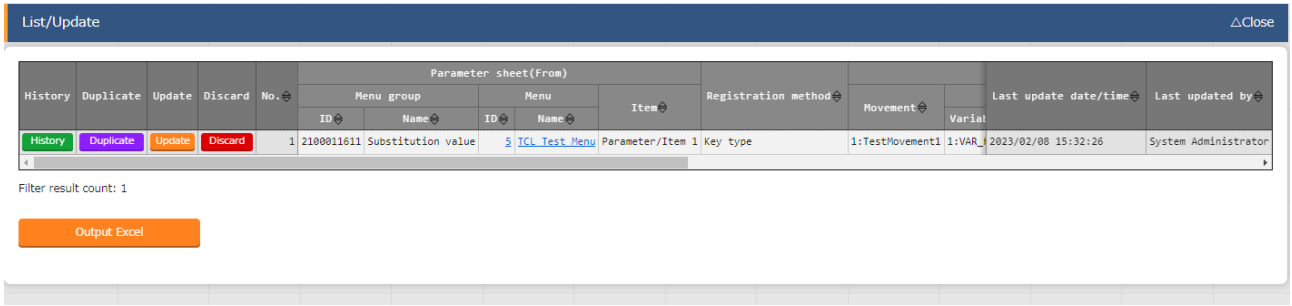


Figure 6.2.11-3 Submenu screen (Substitution value auto-registration settings)

(4) The list of items on the registration screen is as follows.

Figure 6.2.11-1 Item list (Substitution value automatic registration)

Column		Description	Input required	Input type	Restriction
Menu group ：menu		The parameter sheet (with operation) created by the menu creation function is displayed. Select the appropriate parameter sheet.	○	List selection	
Item		The items in the selected parameter sheet are displayed.Select the target item.	○	List selection	
Registration method		Value Type: Select when you want the set value of the item to be the specified value of the linked variable. Key Type: Select when you want the name of the item to be the specified value of the linked variable. If the set value of an item is blank, it will not be linkable. Key-Value Type: Select when you want the name of the item (Key) and the set value (Value) to be used as the specified value of a linked variable.	○	List selection	
Movement		The movement registered in the Movement list is displayed.Select Movement.	○	List selection	
Key information	Variable name	The variables used in the materials registered in the Movement module link are displayed. Select the variable you want to link to the specific value in the Key type.	○	List selection	Required if the registration method is Key or Key-Value type.
	Member variable	If the selected variable name has Member variables, the Member variables will be displayed. Select Member variable.	Depends on Variable name	List selection	
	Substitute order	Only required if multiple specific values can be set to a variable name. The substitute order of the specific values are input starting from (1~). The values are substituted rising from the input value.	Depends on Variable name	Manual input	Must be Blank or a positive integer

Value information	Variable name	The variables used in the materials registered in the Movement module link are displayed. Select the variable you want to link to the specific value in the Value type.	○	List selection	Required if the registration method is Key or Key-Value type.
	HCL Settings	Select "OFF" or "ON". BackYard processing takes over the selected value when it is reflected in the subsititution value list.		List selection	If the selected variable name is “map” type, the HCL settings must be set to “ON”. Make sure that the HCL settings matches the Operation, Movement and/or variable names are the same.
	Member variable	If the selected variable name has Member variables, the Member variables will be displayed. Select Member variable.	Depends on Variable name	List selection	
	Substitute order	Only required if multiple specific values can be set to a variable name. The substitute order of the specific values are input starting from (1~). The values are substituted rising from the input value.	Depends on Variable name	Manual input	Must be Blank or a positive integer
NULL link		If the specific value of the parameter sheet in the "Substitution value auto-registration setting" is NULL(blank), users can set registrations to the list to have the value NULL(blank) or not. This value is applied when "NULL Link"(In the Substitution value auto-registration setting menu) is blank. ・If "Enable", any value in the parameter sheet is registered in the substitution value list. ・If "Disable", the value is registered in the value list only if the parameter sheet contains a value. ・If blank, the "NULL link" value of the interface information is applied.	-	List selection	-
Remarks		Free description field.	-	Manual input	Maxumum length 4000 byte

※If the selected registration method is set to “Key type”, the HCL settings are set to OFF when displayed in the Substitute value list.
※When configuring Member values, make sure to configure the variable’s other member variable’s specific values.
Other values that did not have substitute value set to them will not use default values.

E.g.

・tf file and register values

```
variable "VAR_hoge" {
    type = object({
        IP = string
        NAME = string
    })
    default = {
        IP = “127.0.0.1”
        NAME = “machine01”
    }
}
```

・Substitute value example(Substitute value auto registration settings/ Substitute value list)

No.	Variable name	Member variable	Substitute order	Specific value
1	VAR_hoge	IP	No input required	192.168.0.1
2	VAR_hoge	NAME	No input required	

These values must be configured

5.2.8 Substitution value list

(5) In the “Substitution value list” menu, users can maintain (browse/register/update/abolish) the specific values that substitutes the variables within the Module used by Movements.

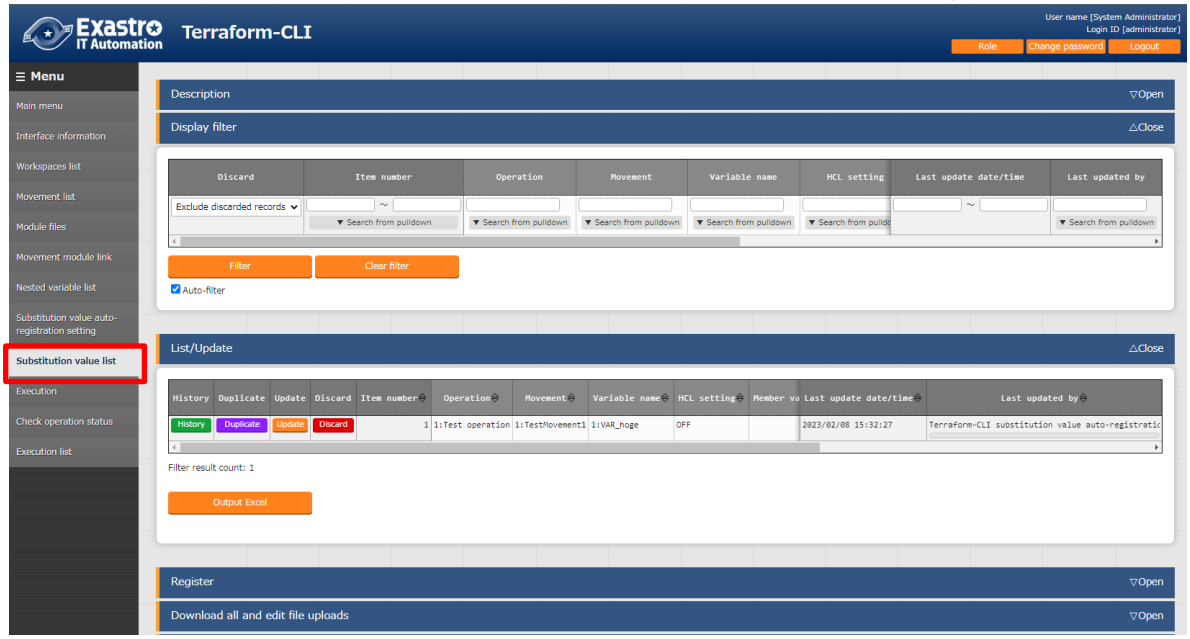


Figure 5.2.88-1 Submenu screen（Substitution value list）

(6) Click the "Register" → "Start registration" button to register Substitute values.

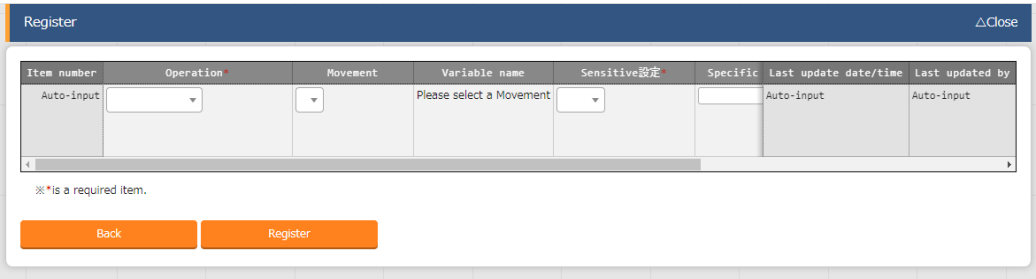


Figure 5.2.88-2 Registration screen（Substitution value list）

The variables in substitution value list are reflected from the file information registered in "5.2.4 Module files"

※Please refer to the timing of reflection is described in "(3) Change of starting period" of " 7.2 Maintenance and Maintaining ".

(7) For the variables registered in the substitution value list, the "variable name" is registered as "Key" and "Specific value" is registered as "Value" for the Variables managed in the Workspace on the Terraform side when the operation is executed.
If "HCL settings" is set to "ON", it will be registered with "HCL" checked.
If "Sentive settings" is set to "ON", it will be registered with "Sentive" checked.

(8) The list of items for assignment value list is as follows.

Table 6.2.12-1 Item list（Substitution value list）

Item	Description	Input required	Input type	Restriction
Operation	Select the target Operation.	○	List selection	-
Movement	Select the target Movement.	○	List selection	-
Variable name	From the Module files registered in the Movement module link, the name of the variable attached to the selected Movement is displayed. Select a variable.	○	List selection	-
HCL settings	Select "OFF" or "ON". If "ON" is selected, "HCL" will be enabled for Variables when they are registered in the Workspace on the Terraform side. Use this setting when configuring a variable to a value that is not a character string.	○	List selection	
Variable name	The variables used in the materials registered in the Movement module link are displayed. Select the variable you want to link to the specific value in the Key type.			
Substitute order	Only required if multiple specific values can be set to a variable name. The substitute order of the specific values are input starting from (1~). The values are substituted rising from the input value.	Depends on Variable name	Manual input	Must be Blank or a positive integer
Default value	Display the specific value linked to the variable within “default”			
Sensitive settings	Select “OFF” or “ON”. If "ON" is elected, the specific value will be encrypted won't be displayed on ITA. Also keep in mind that when registering any variables to the workspace on the Terraform side, "Sensitive" for that variable will be enabled and specific values will not be displayed.	○	List selection	
Specific value	Enter the specific value of the variable to use in Operations/Movements.	○	Manual input	Maximum length 8192 bytes
Remarks	Free description field.	-	Manual input	Maximum length 4000 bytes

5.2.3

5.2.9 Execution

(1) The “Execution” menu allows users to execute operations. The users can use the radio buttons to select which Movement and Operation to execute. Pressing the “Execute” button on the bottom of the screen will move the user to “5.2.10 Check operation status” where the operation is run.

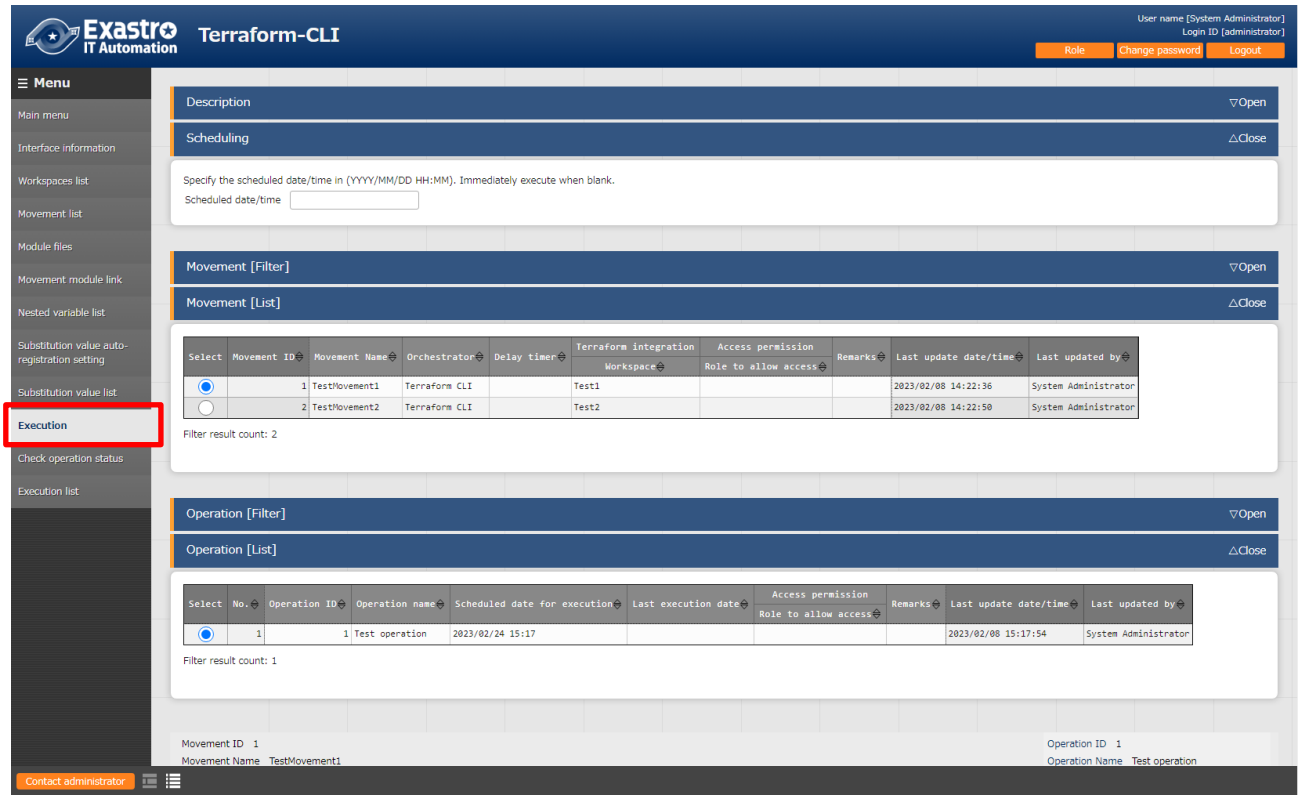


Figure 6.2.14-1 Submenu screen（Execution）

① **Specify scheduled date/time**
Users can reserve Execution and Plan confirmations by entering the "Scheduled date/time".
Only date/time can be registered for "Schedule date/time"

② **Specify Movement**
Select the Movement registered in the "5.2.3 Movement list".

③ **Specify Operation**
Select the Operation registered in the "5.1.1 Operation list".

④ **Execution**
Clicking the "Execute" button will move the user to ""5.2.10 Check operation status"" and execute the operation.
"Apply" will automatically be executed after the Plan and/or the PolicyCheck are completed.

⑤ **Plan confirmation**
Clicking the "Plan Confirmation" button will similarly to clicking the "Execute" button, start the execution. However, "Discard Run" will be applied to RUN after the Plan and PolicyCheck are completed, and "Apply" will not be executed.

If a module with an output block is run with Conductor,
the contents of the output block will be saved to the deta relay storage path(shared movement directory) as a json file.
This file allows users to use a value output by Terraform from a different Movement (in the same conductor).

File path:
[Data relay storage path]/[Conductor instance ID]/terraform_output_[Operation No].json
Example :
/exastro/data_relay_storage/conductor/0000000001/terraform_output_0000000001.json

Data relay storage path -[Conductor]-[Conductor interface information] - [Data relay storage path]
Conductor instance ID･･･[Conductor]-[Conductor list] - [Conductor instance ID]（The 10 numbers from the left.）

Operation No.･･･ [Terraform]-[Execution list] - [Operation No.]（The 10 numbers from the left.）
Description

```
variable "VAR_sample" {
  type = string
  default = "sample_string"
}
output "output_sample" {
  value = "${var.VAR_sample}"
}
```

Output

```
{
  "output_sample": "sample_string"
}
```

5.2.10 **Check operation status**

(1) This page allows users to monitor the operation execution status.

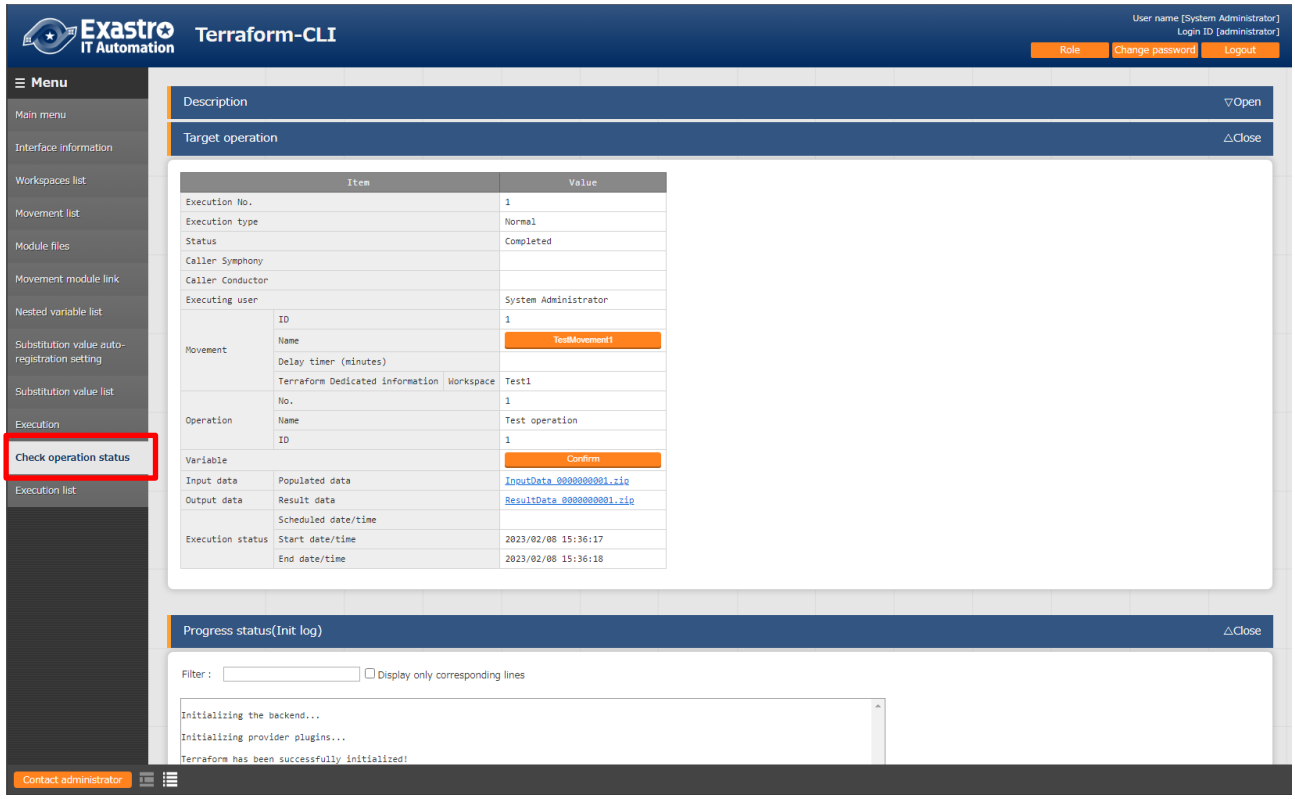


Figure 5.2.100-1 Submenu screen（Check operation status）

① Display of execution status

The Status displayed matches the Execution status of the operation.
The "Execution Type" will contain "Plan Confirmation" for plan confirmations, and "Normal" for other cases.

Execution log for Progress (Plan Log), Progress (PolicyCheck Log) and Progress (Apply Log) executed in Terraform are displayed in Plan/ PolicyCheck / Apply.

If the status displays “unexpected error”, the Progress status (Error log) will display a message if there might be an issue with the contents registered to “5.2.1 Interface information” or with registered web contents.
Other errors will not be displays in the Progress status (error log), but in the Process log.
※Please refer to "④ Log file name" in " 7.2 Maintenance and Maintaining" for the process log.

“Call Symphony”, displays which Symphony was executed. It will be blank if you execute it directly from the Terraform driver or from Conductor.
In “Call Conductor”, displays which Conductor was executed. It is blank if you execute it directly from the Terraform driver or from Symphony.

"Execution user" displays the user logged in when the "Execute" button was pressed from the execution menu.

※If the “Execution type” is set to “Delete resources”, the following items will not be configured.
・Called Symphony
・CalledConductor
・Movement（ID、name、Data delay（min））
・Operation（No.、name、ID）
・Substitute value
・Input data

② Substitution value confirmation

By clicking the "confirmation" button, "5.2.8 Substitution value list" will display and the substitution value filtered by the operation and Movement of operation target will be displayed.

③ Emergency stop/Schedule cancellation

It is possible to stop the construction operation by clicking the "Emergency stop" button. In addition, for the "scheduled execution" operation before execution, the "schedule cancellation" button will display. Cancel the scheduled execution by clicking the "schedule cancellation" button.

④ Log filter

Execution log and error log can be filtered. By entering the string that the user wants to search in the filter box of each log and checking the "Display only corresponding lines" checkbox, only the corresponding line will be displayed. The display refresh cycle and the maximum display line count of exeuction and error log can be set in "Status monitoring cycle (milliseconds)" and "Number of rows to display progress status" of "5.2.1 Interface information" menu.

⑤ Input data

Users can download executed module files and a zip file containing a list of policy materials and the configured substitute values in Json format. The files are as following:

Table 5.2.100-1 Input data files

File name	Description
(Input Module file name)	Contains all the input module files. Stored directly under the zip file.
Terraform.tfvars	Contains “Variable name(Key)” and “Specific value(Value)” for the set substitute values. Does not contain data for items with Secure settings set to ON.

⑥ Result data

User can download execution logs, error logs, and state files generated by Terraform.

Table 5.2.100-2 Result data files

File name	Description
Init.log	Log file that contains the contents output to the progress status(init log)
plan.log	Log file that contains the contents output to the progress (plan) log.
apply.log	Log files that contains the contents output to the progress (apply) log.
error.log	Log files that contains the contents output to the progress (error) log.
result.txt	File that describes the proress status used by BackYard when executing operations.
.terraform.lock.hcl	File generated by Terraform. Contains provider nad module information.
terraform.tfstate	State file generated by Terraform. Is saved as an encrypted file.
terraform.tfstate.backup	A backup of the state file generated by Terraform. Is saved as an encrypted file.

5.2.11 **Execution list**

(2) This menu allows users to view operation history.
The operation list table and graph can be displayed by specifying display criteria and clicking the "filter" button.

Clicking the "Check execution status" button, will move the user to “5.2.10 Check operation status" where they can view a detailed execution status.

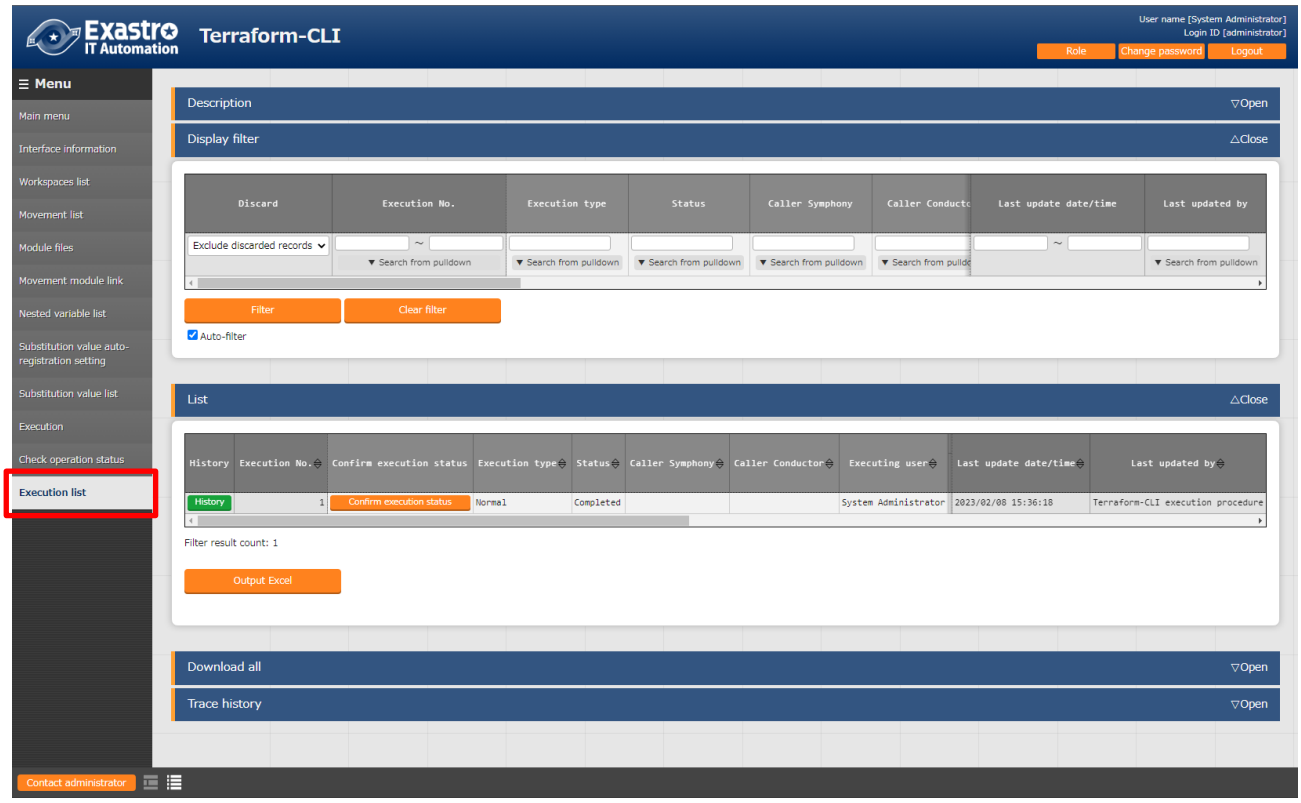


Figure 5.2.111-1 Submenu screen（Execution list）

6 How to write construction code

Describes the description of Module and Policy in Terraform driver.

6.1 Module description

Module files are written in HashiCorp's own language called HCL (HashiCorp Configuration Language).

For more information on HCL, see the Terraform product documentation.

6.2 BackYard Content

(1) Automatic variable registration

This function extracts variables from the Module files registered in "5.2.4 Module files".
Please refer to "2.1 Variable types" for more information regarding "Variable extraction rules".
Additionally, the timing of the extraction depends on the startup cycle of the "Automatic Terraform Variables Registration" process.

(2) Automatic Substitute Value Registration Settings

The Information from the movement and variables linked to the set values of Operation itens in the target parameter sheets is reflected in the Substitute Value list.
The timing of the extraction depends on the startup cycle of the "Terraform Auto Registration Settings" process.
The Substitute value list can be updated by multiple operators. If the last update was performed by another operator, it will not be reflected.
If you want to reflect the data of the Automatic Substitute value registration settings, please delete the corresponding record in the Substitute Value list.

The rules for reflecting the substitution value list are written below.

① **When the information registered in the Substitution value automatic registration is reflected in the Substitution value list**

Substitution value list status	Without applicable record	With applicable record			Record abolishing
		= Specific value	≠ Specific value		
			Last update		
			BackYard process	Other operators	
Reflected to substitution value list	Add new record	-	Update specific values for the applicable record	-	Abolition record revival

※Applicable record: Operation + Movement + Variable name + HCL configuration + Records with the same access permission.

② **Information not registered in substitution value automatic registration (registered only for the substitution value list) is reflected in the subsitution value list.**

Substitution value list status	With applicable record	
	Last update	
	BackYard process	Other operators
Reflected to substitution value list	Record abolishing	-

③ **HCL settings**

The value of the "HCL setting" configured for substitution value automatic registration is set to the same value when reflected in the substitution value list.

④ **Sensitive settings**

If the item in the Link-target parameter sheet is set to "Password", the "Sensitive settings" will be set to "ON" when reflected in the Substitution value list.

⑤ **Access permission roles**

The access permission role of the operation set in the record of the link-target parameter sheet and the access permission role of the Movement set in the record of automatic assignment value registration are referred to, and all matching access permission roles are set when reflected in the Substitute value list.

If no permission role is set for either of them (blank), the blank space will also be set when reflected in the Substitute Value list.

Additionally, if there are no single matching permission roles, no record will be created in the Substitute Value list.

7 Application operation

The operation to utilize ITA system contains not only inputs by user from the browser screen of client PC but also operations according to system operation and maintenance. The available operation and maintenance are as follows.

7.1 Maintenance

The files required to start/stop/restart Terraform driver processes are as follows.

Description	Target file name
Terraform operation execution monitoring Execute the unexecuted Operation.	ky_terraform_execute-workflow.service
Terraform operation execution monitoring Check the status of executing work and acquire logs.	ky_terraform_checkcondition-workflow.service
Terraform variable automatic registration Remove variables from uploaded Module files.	ky_terraform_varsautolistup-workflow.service
Terraform auto registration settings The information configured for substitution value automatic registration is reflected in the substitution value list.	ky_terraform_valautosetup-workflow.service

The target file is stored in “/usr/ lib/systemd/system”.
The method of Starting/Stopping/Restarting a process is as follows. Please execute the command with root permission.

① Start process

```
# systemctl start ky_terraform_execute-workflow.service
```

② Stop process

```
# systemctl stop ky_terraform_execute-workflow.service
```

③ Restart Process

```
# systemctl restart ky_terraform_execute-workflow.service
```

Please replace each target file name with a start/stop/restart.

7.2 Maintenance and Maintaining

① Change to NORMAL level

Rewrite line 8 of the following file with "DEBUG" to NORMAL.

Log level configuration file: <installation directory> /ita-root/confs/backyardconfs/ita_env

② Change to DEBUG level

Rewrite line 8 of the following file with "DEBUG" to NORMAL.

Log level configuration file: <installation directory>/ita-root/confs/backyardconfs/ita_env

③ Change the startup period

Change the 5th parameter of ExecStart of each target file. (Unit: seconds)

With exceptions, use the default value for the startup period.

```
ExecStart=/bin/sh ${ITA_ROOT_DIR}/backyards/common/ky_loopcall-php-procedure.sh
/bin/php /bin/php ${ITA_ROOT_DIR}/backyards/terraform_driver/ky_terraform_execute-
workflow.php ${ITA_ROOT_DIR}/logs/backyardlogs 5 ${ITA_LOG_LEVEL} > /dev/null 2>&1
```

After rewriting the file, **it enables after the process is restarted.**

④ Log file name

Process name	Log file name
ky_terraform_execute-workflow	ky_terraform_execute-workflow_YYYYMMDD.log
ky_terraform_checkcondition-workflow	ky_terraform_checkcondition-workflow_YYYYMMDD.log
ky_terraform_varsautolistup-workflow	ky_terraform_varsautolistup-workflow_YYYYMMDD.log
ky_terraform_valautosetup-workflow	ky_terraform_valautosetup-workflow_YYYYMMDD.log

Log file output directory: <installation directory> /ita-root/logs/backyardlogs

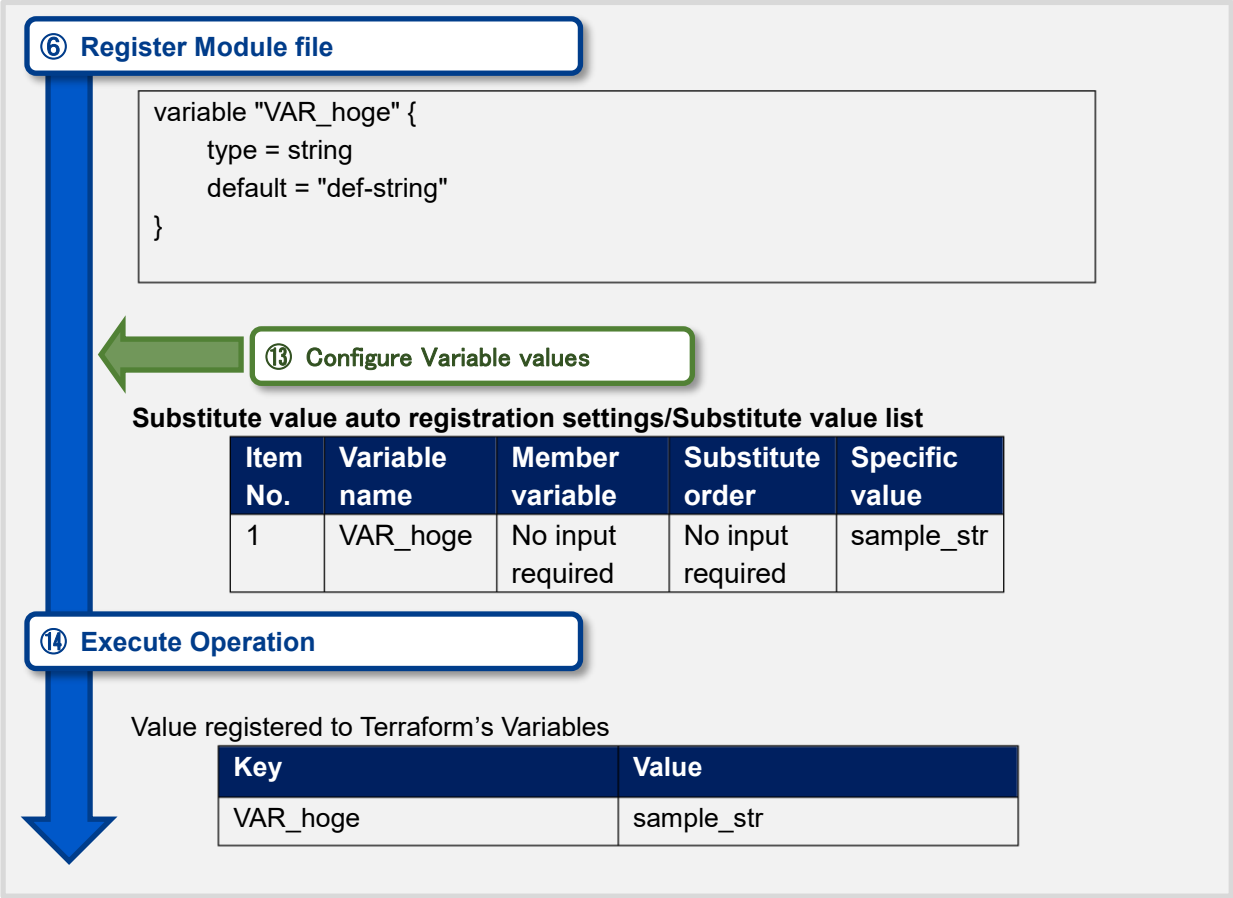
8 Appendix

8.1 Module file input example/ register example

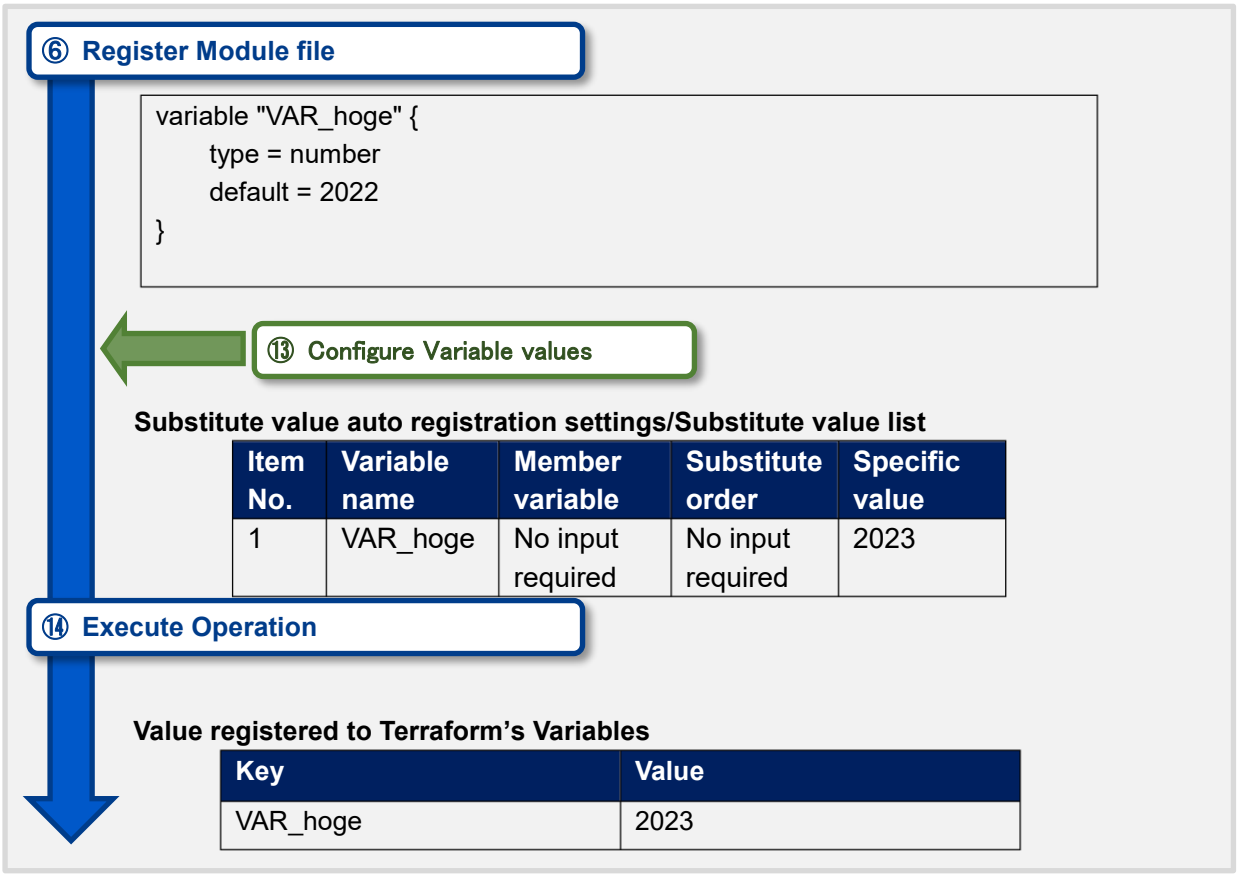
The following section are examples of inputting and registering module files in relation to the flow number in "4.1 Terraform Workflow".

(1) Simple pattern

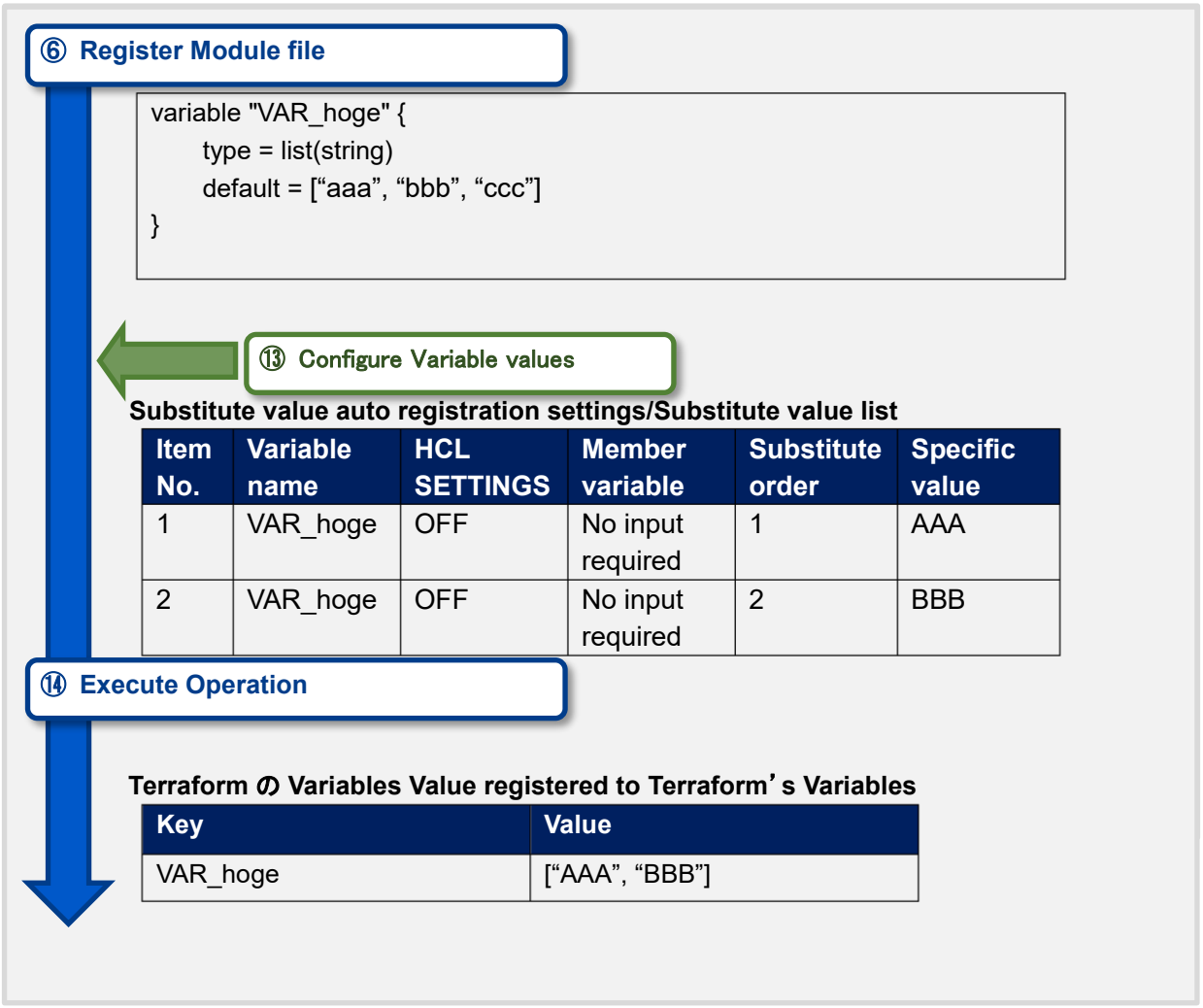
1. string type



2. number type

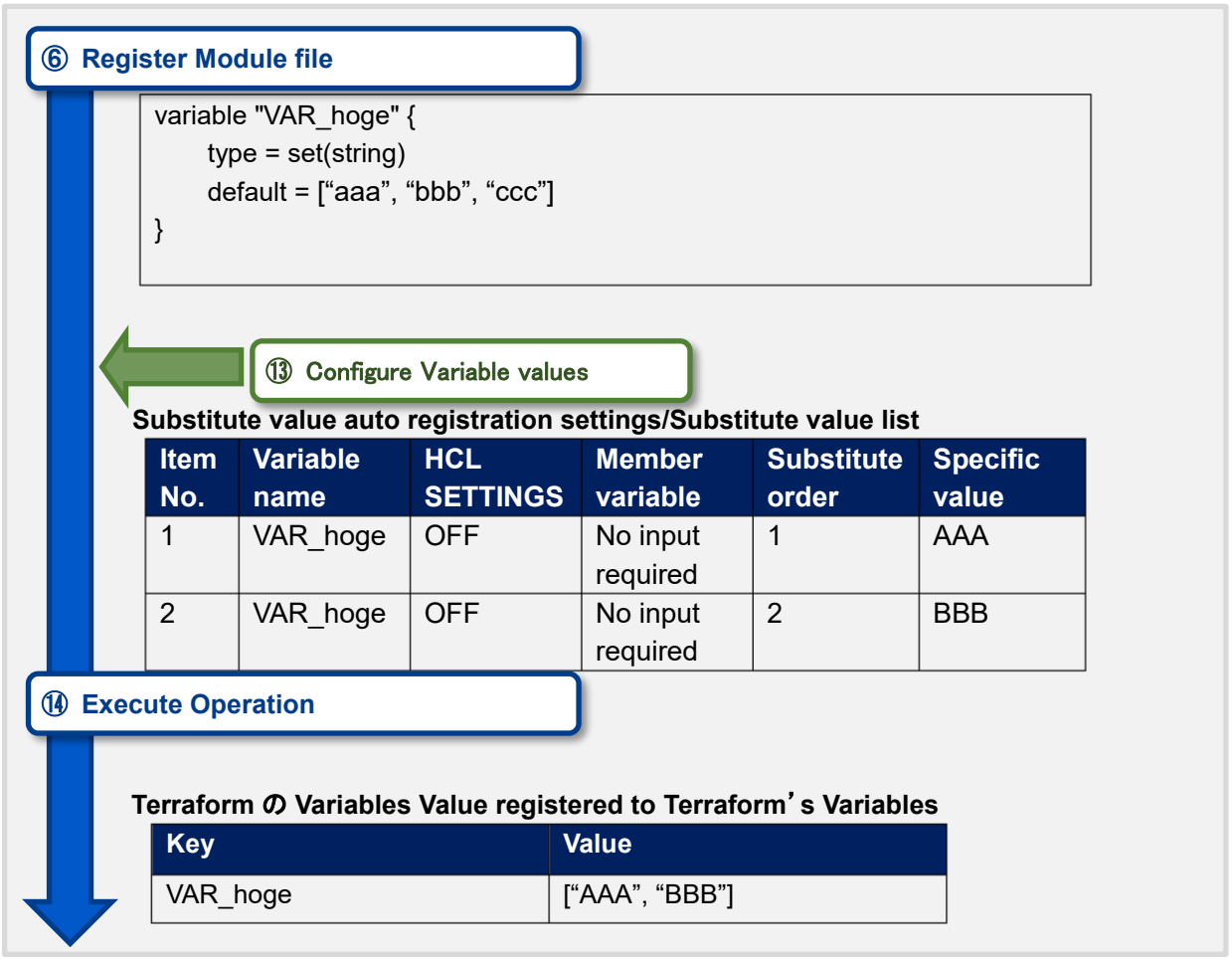


3. bool type

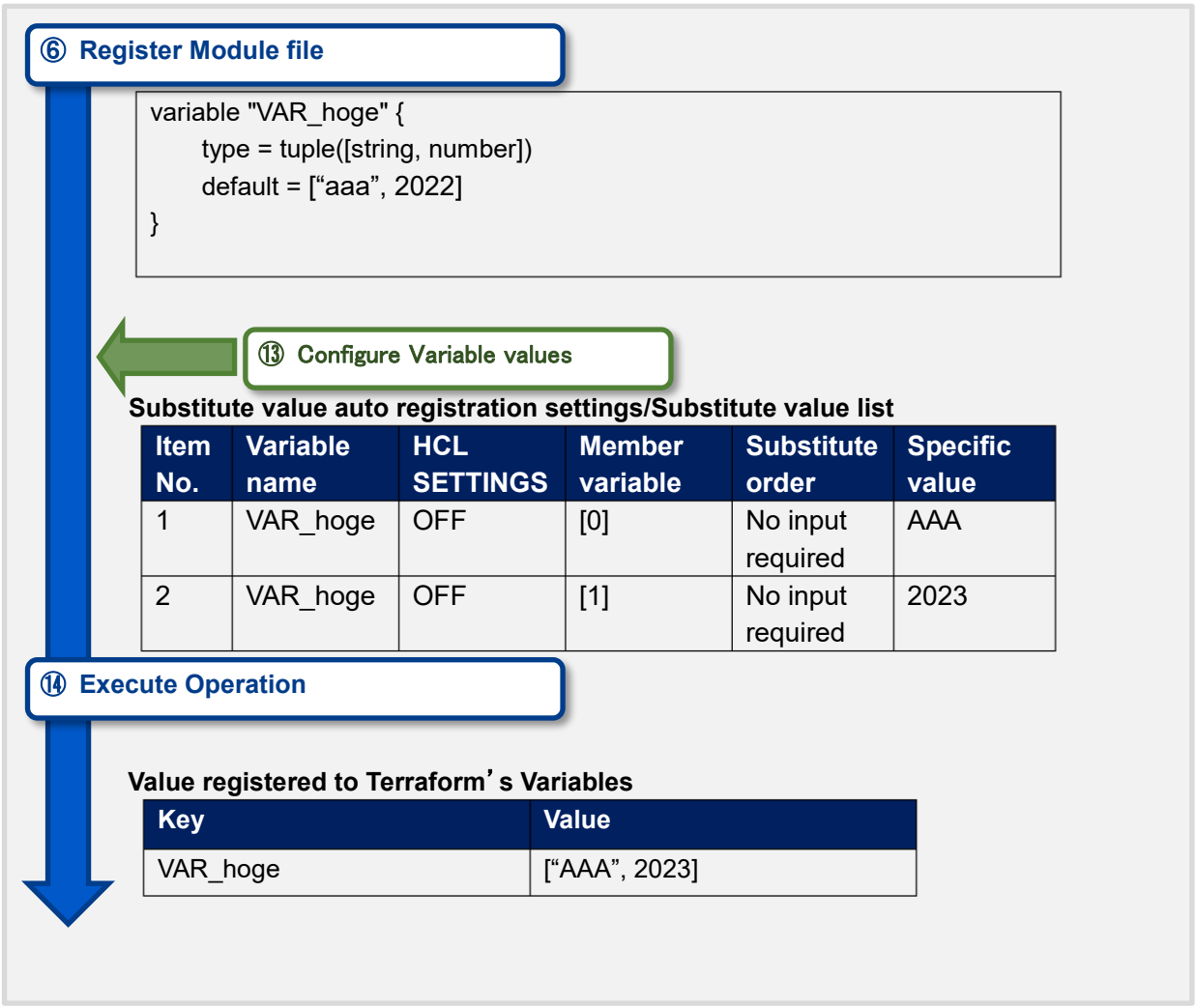


4. list type

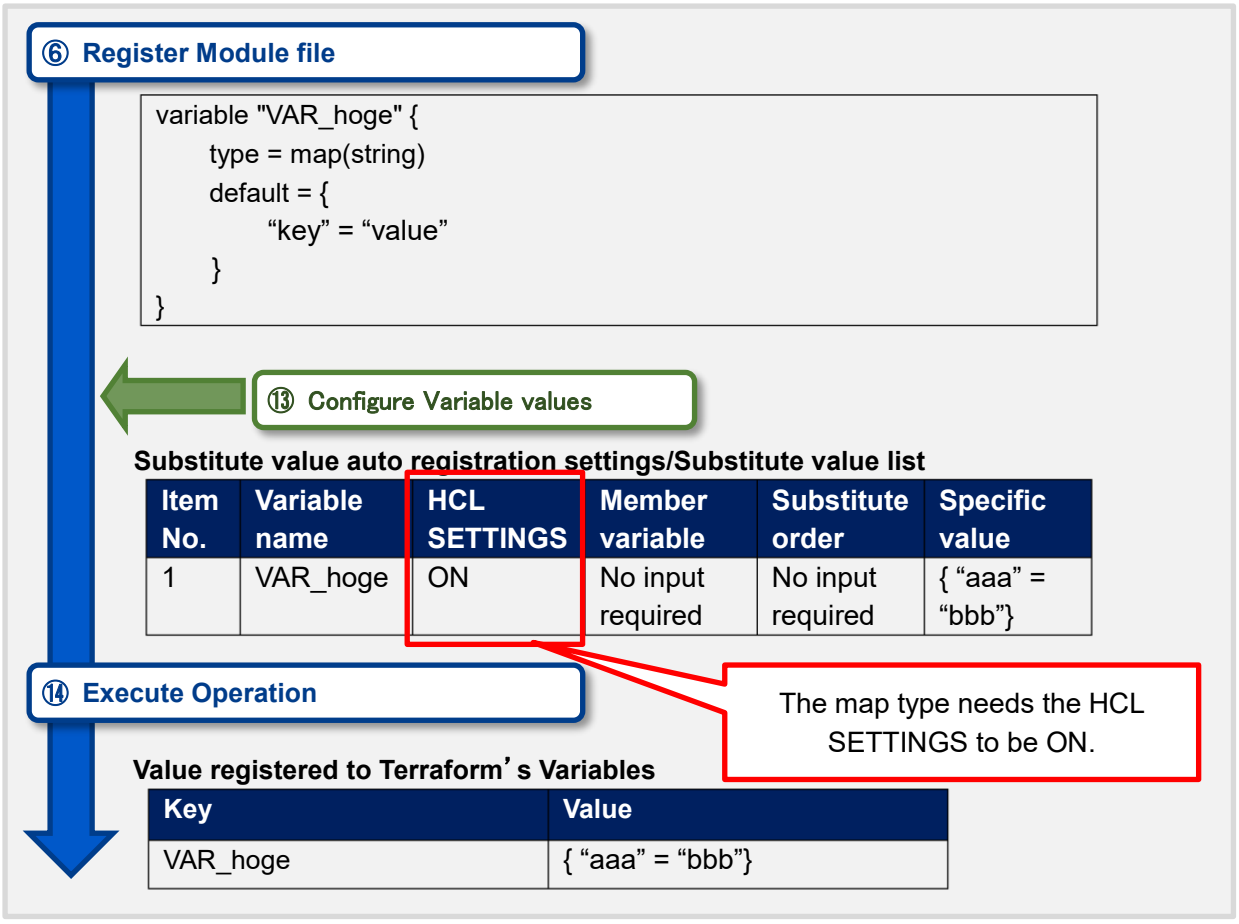
5. set type


⑥ Register Module file
variable "VAR_hoge" {
type = set(string)
default = [“aaa”, “bbb”, “ccc”]
}
⑬ Configure Variable values
Substitute value auto registration settings/Substitute value list
Item No. | Variable name | HCL SETTINGS | Member variable | Substitute order | Specific value
1 | VAR_hoge | OFF | No input required | 1 | AAA
2 | VAR_hoge | OFF | No input required | 2 | BBB
⑭ Execute Operation
Terraform の Variables Value registered to Terraform’s Variables
Key | Value
VAR_hoge | [“AAA”, “BBB”]

6. tuple type


⑥ Register Module file
variable "VAR_hoge" {
type = tuple([string, number])
default = [“aaa”, 2022]
}
⑬ Configure Variable values
Substitute value auto registration settings/Substitute value list
Item No. | Variable name | HCL SETTINGS | Member variable | Substitute order | Specific value
1 | VAR_hoge | OFF | [0] | No input required | AAA
2 | VAR_hoge | OFF | [1] | No input required | 2023
⑭ Execute Operation
Value registered to Terraform’s Variables
Key | Value
VAR_hoge | [“AAA”, 2023]

7. map type


⑥ Register Module file
variable "VAR_hoge" {
type = map(string)
default = {
“key” = “value”
}
}
⑬ Configure Variable values
Substitute value auto registration settings/Substitute value list
Item No.
Variable name
HCL SETTINGS
Member variable
Substitute order
Specific value
1
VAR_hoge
ON
No input required
No input required
{ “aaa” = “bbb”}
⑭ Execute Operation
The map type needs the HCL SETTINGS to be ON.
Value registered to Terraform’s Variables
Key
Value
VAR_hoge
{ “aaa” = “bbb”}

8. object type

⑥ Register Module file

```
variable "VAR_hoge" {
      type = object({
            IP = string,
            NAME = string
      })
      default = {
            “IP” = “127.0.0.1”,
            “NAME” = “machine01”
      }
}
```

⑬ Configure Variable values

Substitute value auto registration settings/Substitute value list

Item No.	Variable name	HCL SETTINGS	Member variable	Substitute order	Specific value
1	VAR_hoge	OFF	IP	No input required	192.168.0.1
2	VAR_hoge	OFF	NAME	No input required	my_machine

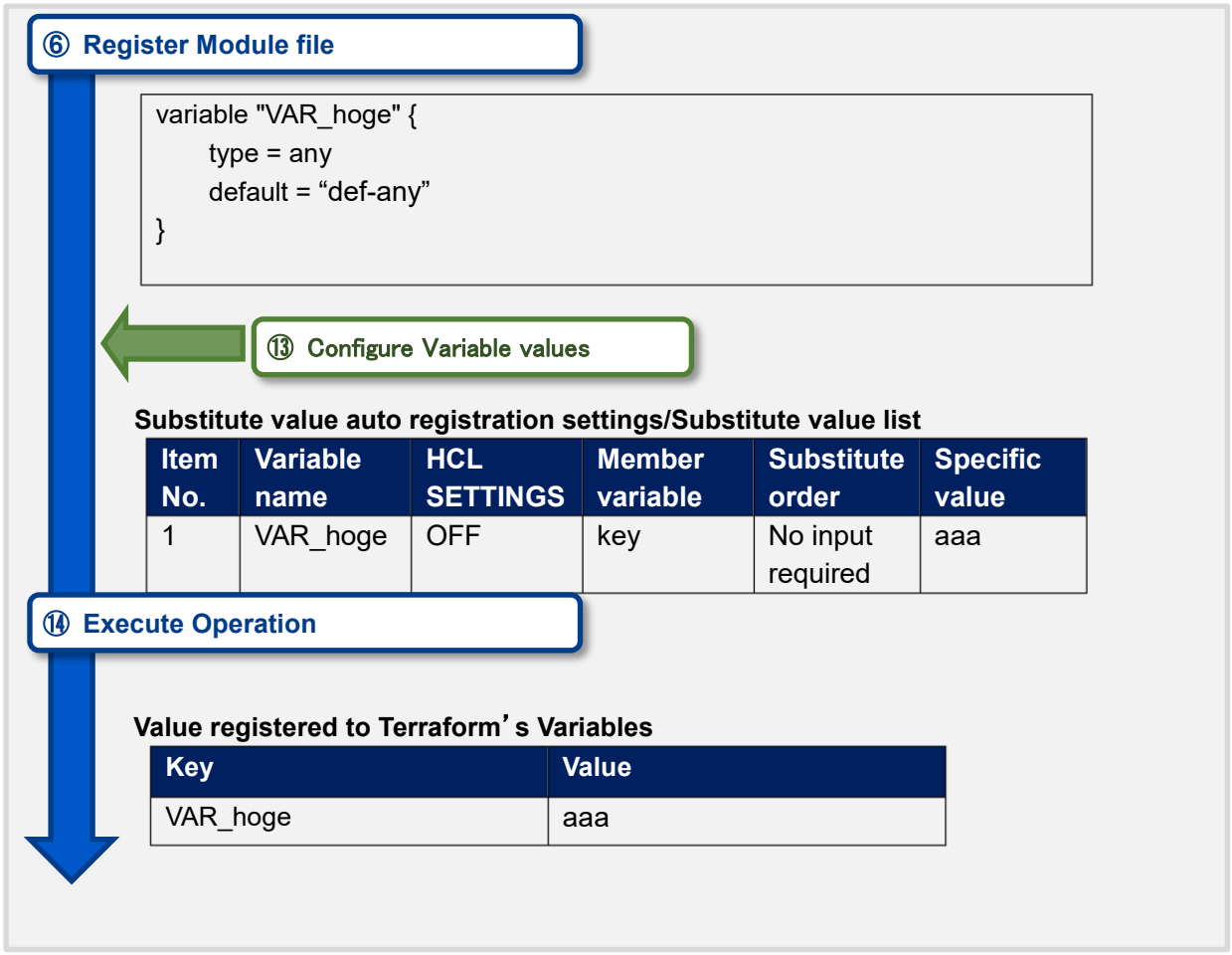
⑭ Execute Operation

Value registered to Terraform’s Variables

Key	Value

VAR_hoge	{
	“IP” = “192.168.0.1”,
	“NAME” = “my_machine”
	}

9. any type



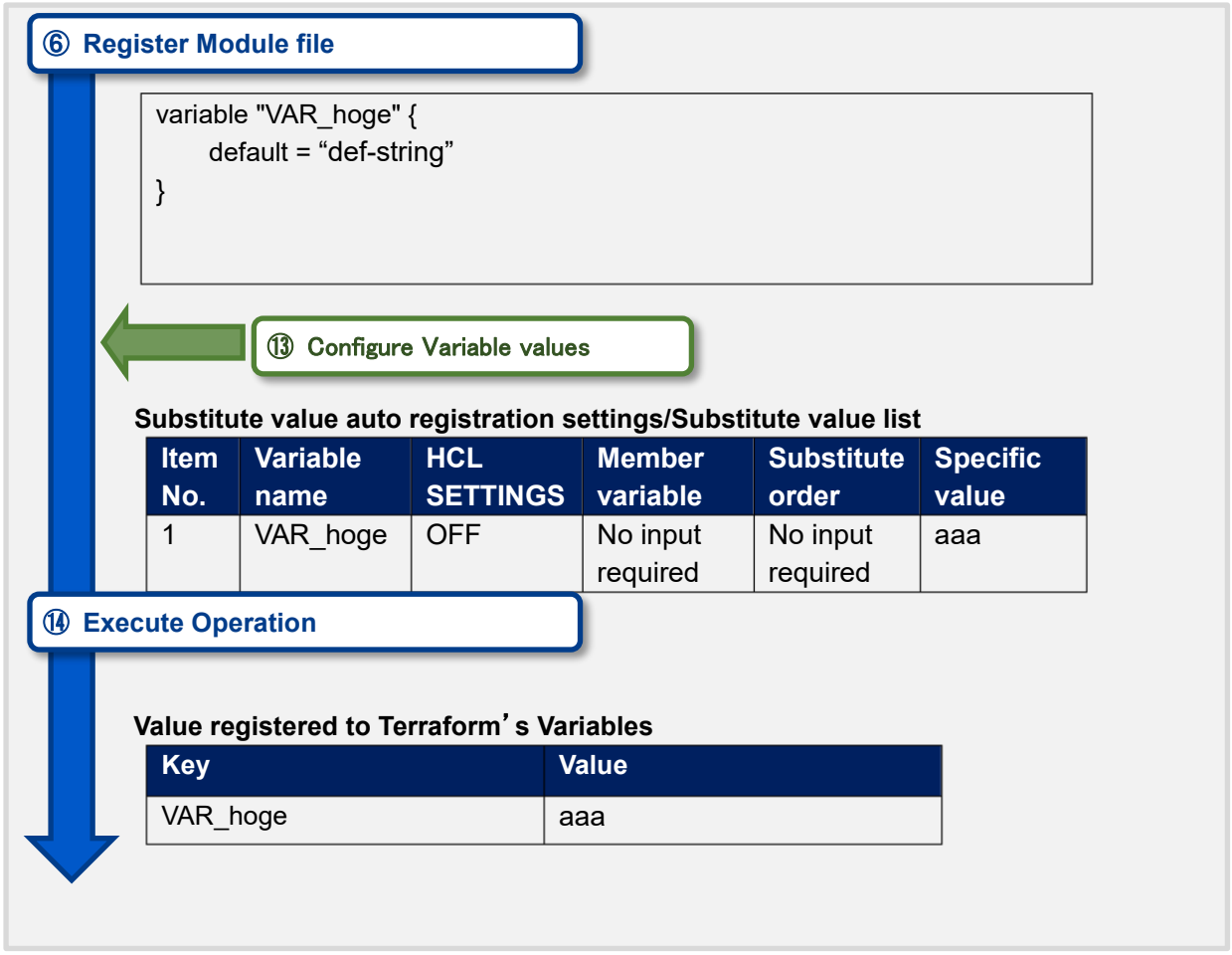
Substitute value auto registration settings/Substitute value list

Item No.	Variable name	HCL SETTINGS	Member variable	Substitute order	Specific value
1	VAR_hoge	OFF	key	No input required	aaa

Value registered to Terraform’s Variables

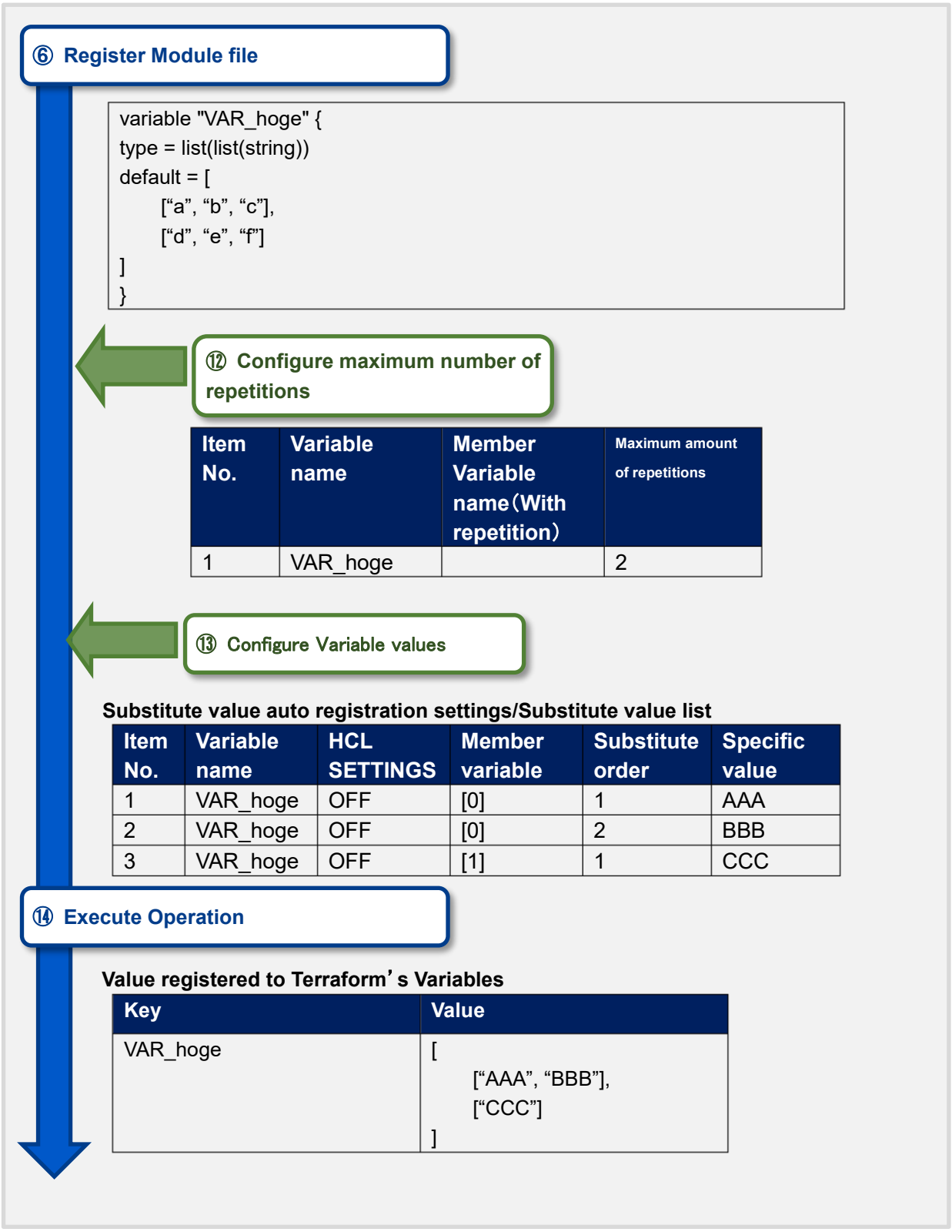
Key	Value
VAR_hoge	aaa

10. Description with no type



(2) Complex pattern

① list typearraylist



Item No.	Variable name	Member Variable name(With repetition)	Maximum amount of repetitions
1	VAR_hoge		2

Item No.	Variable name	HCL SETTINGS	Member variable	Substitute order	Specific value
1	VAR_hoge	OFF	[0]	1	AAA
2	VAR_hoge	OFF	[0]	2	BBB
3	VAR_hoge	OFF	[1]	1	CCC

Key	Value
VAR_hoge	[["AAA", "BBB"], ["CCC"]]

② list type objects

⑥ Register Module file

```
variable "VAR_hoge" {
type = list(
object({
      NAME = string
      AGE = number
})
)
default = [
      { “NAME” = “Tanaka”, “AGE” = 30 },
      { “NAME” = “Yamamoto”, ” AGE” = 26 }
]
}
```

⑫ Configure maximum number of repetitions

Nested variable list

Item No.	Variable name	Member Variable name（With repetition）	Maximum amount of repetitions
1	VAR_hoge		2

⑬ Configure Variable values

Substitute value auto registration settings/Substitute value list

Item No.	Variable name	HCL SETTINGS	Member variable	Substitute order	Specific value
1	VAR_hoge	OFF	[0].NAME	No input required	HONDA
2	VAR_hoge	OFF	[0].AGE	No input required	20
3	VAR_hoge	OFF	[1].NAME	No input required	OGIKUBO
4	VAR_hoge	OFF	[1].AGE	No input required	50

⑭ Execute Operation

Value registered to Terraform’s Variables

Key	Value
VAR_hoge	[{“NAME” = “HONDA”, “AGE” = 20} {“NAME” = “OGIKUBO”, “AGE” = 50}]

③ object’s list objects

⑥ Register Module file

```
variable "VAR_hoge" {
      type = object({
            FRUIT = list(object{
                  NAME = string, PRICE = number
            }),
            VEGETABLE = l ist(object{
                  NAME = string, PRICE = number
            })
      })
      default = {
            FRUIT = [
                  { NAME = “Apple”, PRICE = 120 },
                  { NAME = “Orange”, PRICE = 80 }
            ],
            VEGETABLE = [
                  { NAME = “Eggplant”, PRICE = 100 },
                  { NAME = “Tomato”, PRICE = 200 }
            ]
      }
}
```

⑫ Configure maximum number of repetitions

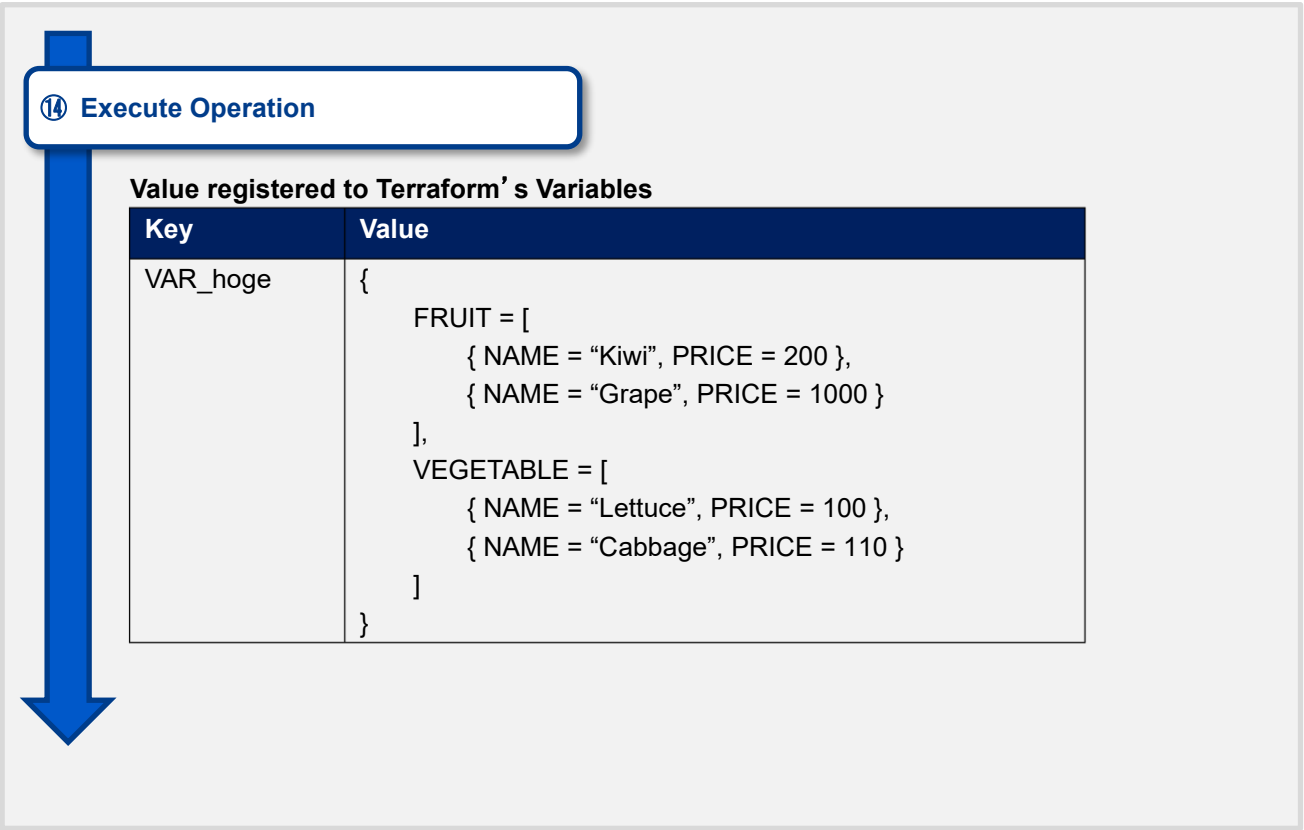
Nested variable list

Item No.	Variable name	Member Variable name（With repetition）	Maximum amount of repetitions
1	VAR_hoge	FRUIT	2
2	VAR_hoge	VEGETABLE	2

⑬ Configure Variable values

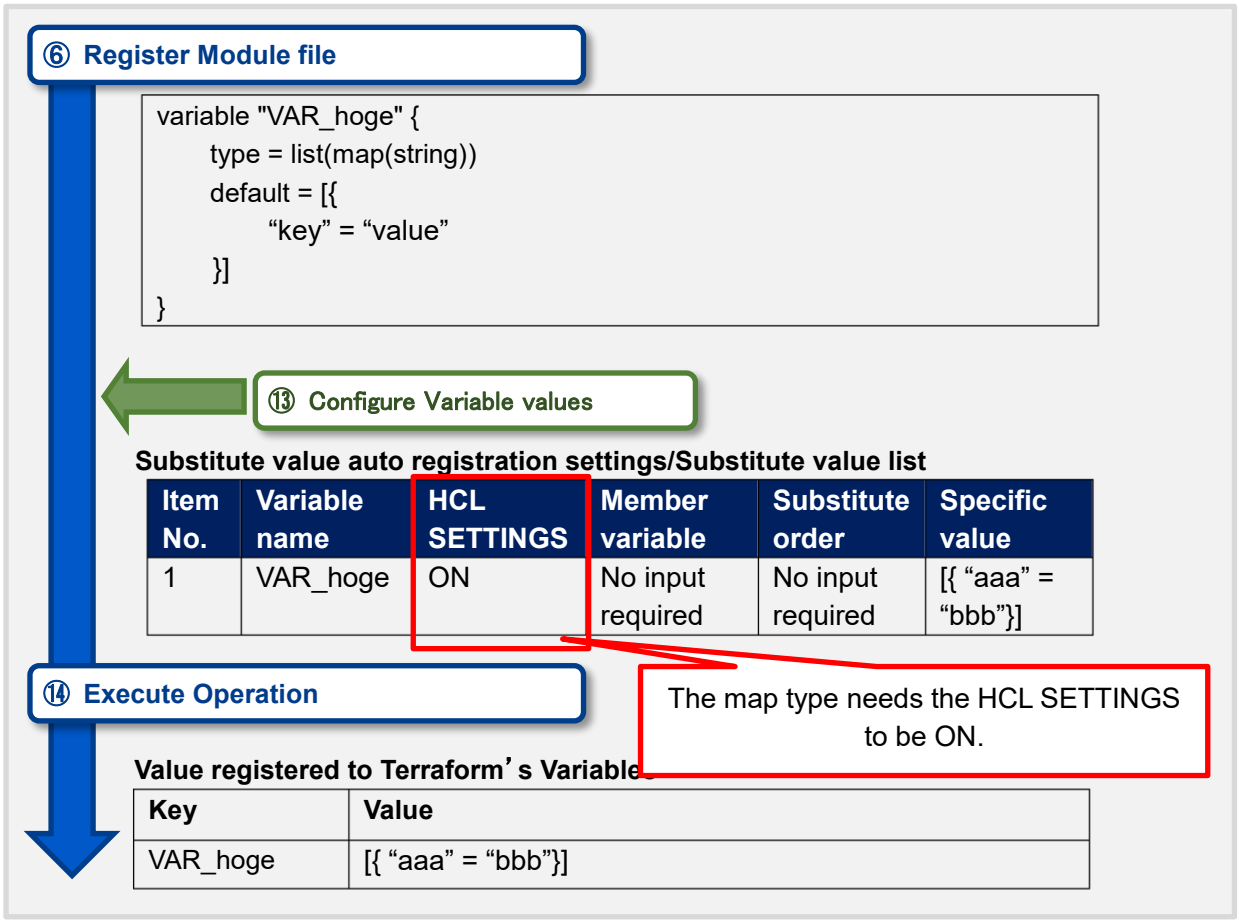
Substitute value auto registration settings/Substitute value list

Item No.	Variable name	HCL SETTINGS	Member variable	Substitute order	Specific value
1	VAR_hoge	OFF	FRUIT.[0].NAME	No input required	Kiwi
2	VAR_hoge	OFF	FRUIT.[0].PRICE	No input required	200
3	VAR_hoge	OFF	FRUIT.[1].NAME	No input required	Grape
4	VAR_hoge	OFF	FRUIT.[1].PRICE	No input required	1000
5	VAR_hoge	OFF	VEGETABLE.[0].NAME	No input required	Lettuce
6	VAR_hoge	OFF	VEGETABLE.[0].PRICE	No input required	100
7	VAR_hoge	OFF	VEGETABLE.[1].NAME	No input required	Cabbage
8	VAR_hoge	OFF	VEGETABLE.[1].PRICE	No input required	110



(3) Special types

① Map type under list type



8.2 Nested variable list flow example

The following example is reference to the Terraform CLI driver workflow's "5.2.6 Nested variable list"

(1) Increase amount of maximum amount of repetitions.

⑥ Register Module file

```
variable "VAR_hoge" {
      type = list(object({ IP = string, NAME = string }))
default = [
            { "IP" = "127.0.0.1", NAME = "machine01"},
            { "IP" = "127.0.0.2", NAME = "machine02"}
      ],
}
```

⑫ Configure maximum amount of repetitions

Nested variable list(When registering)

Item No.	Variable name	Member Variable name(With repetition)	Maximum amount of repetitions
1	VAR_hoge		2

Nested variable list(When updating)

Item No.	Variable name	Member Variable name (With repetition)	Maximum amount of repetitions
1	VAR_hoge		3

⑬ Configure Variable values

Substitute value auto registration settings/Substitute value list

Item No.	Variable name	HCL SETTINGS	Member variable	Substitute order	Specific value
1	VAR_hoge	OFF	[0].IP	No input required	192.168.1.1
2	VAR_hoge	OFF	[0].NAME	No input required	yamamoto
3	VAR_hoge	OFF	[1].IP	No input required	192.168.1.2
4	VAR_hoge	OFF	[1].NAME	No input required	suzuki
5	VAR_hoge	OFF	[2].IP	No input required	192.168.1.3
6	VAR_hoge	OFF	[2].NAME	No input required	tanaka

Member variable added from updating the Nested variable list.

⑥ **Register Module file**

```
variable "VAR_hoge" {
      type = list(object({ IP = string, NAME = string }))
default = [
            { “IP” = “127.0.0.1”, NAME = “machine01”},
            { “IP” = “127.0.0.2”, NAME = “machine02”},
            { “IP” = “127.0.0.3”, NAME = “machine03”}
      ],
}
```

Nested variable list（When registering）

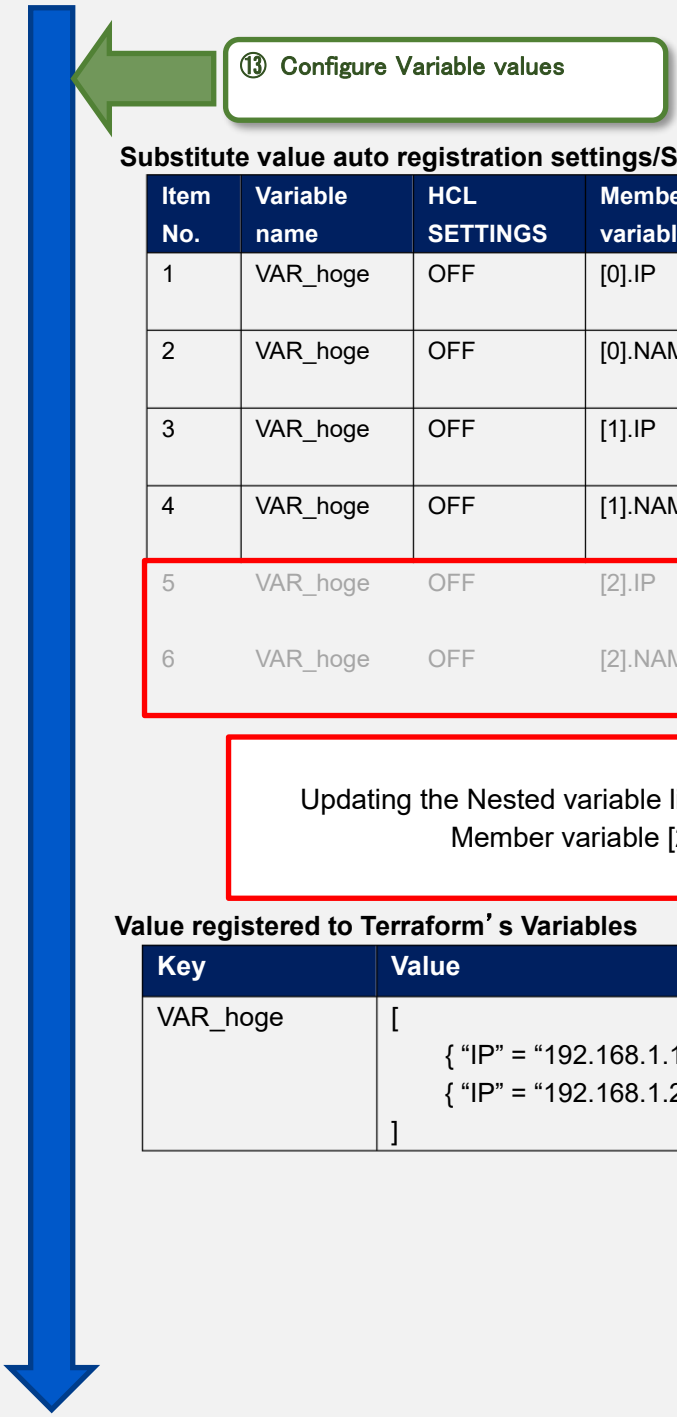
Item No.	Variable name	Member Variable name (With repetitions)	Maximum amount of repetitions
1	VAR_hoge		3

Nested variable list（When updating）

Item No.	Variable name	Member Variable name (With repetitions)	Maximum amount of repetitions
1	VAR_hoge		2

(2) Decreasing maximum amount of repetitions

999



Substitute value auto registration settings/Substitute value list

Item No.	Variable name	HCL SETTINGS	Member variable	Substitute order	Specific value
1	VAR_hoge	OFF	[0].IP	No input required	192.168.1.1
2	VAR_hoge	OFF	[0].NAME	No input required	yamamoto
3	VAR_hoge	OFF	[1].IP	No input required	192.168.1.2
4	VAR_hoge	OFF	[1].NAME	No input required	suzuki
5	VAR_hoge	OFF	[2].IP	No input required	
6	VAR_hoge	OFF	[2].NAME	No input required	

Updating the Nested variable list made it not possible to select Member variable [2].IP and [2].NAME.

Value registered to Terraform’s Variables

Key	Value
VAR_hoge	[{ “IP” = “192.168.1.1”, “NAME” = “yamamoto” }, { “IP” = “192.168.1.2”, “NAME” = “suzuki” },]