

Streamlining Target Fabrication Requests at the National Ignition Facility

ICALEPCS 2017

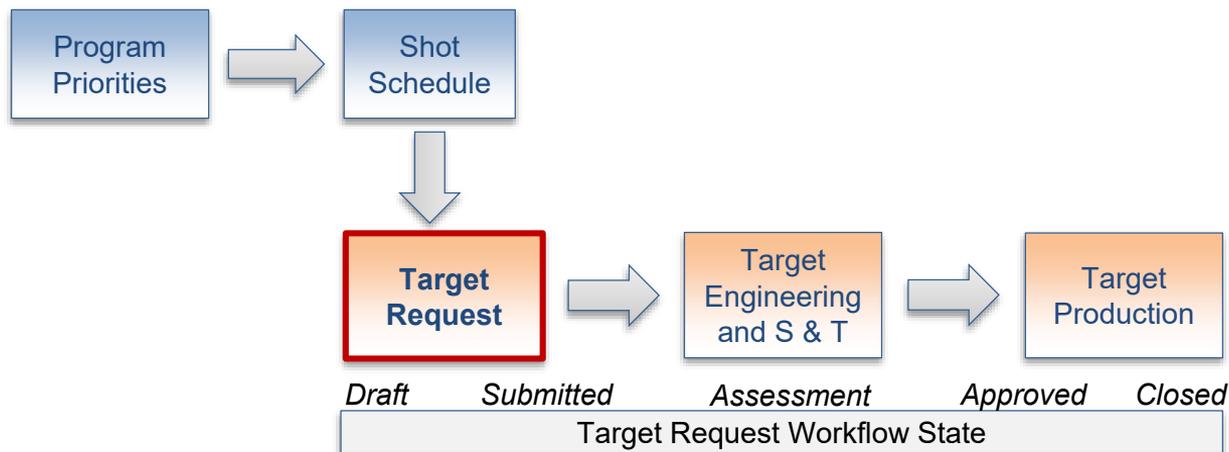
October 10, 2017

**Carla Manin, George Norman, Essex
Bond, Raelyn Clark, Allan Casey**
NIF Shot Data Systems

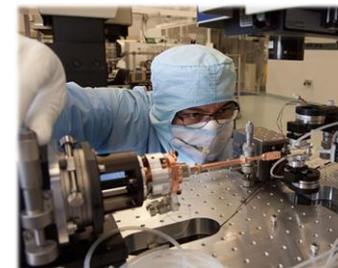


NIF Target Fabrication Background

- Estimated 500 targets produced each year.
- Targets are usually standard but many need to be customized.
- Each target produced is paired with an experiment and a request.
- Requests go through a series of approvals before a target is fabricated.



Example of a target



Technician at target fabrication facility

A software application has been used to manage the target requests.

Former Target Request tool

CLARK94 Logout

Target Summary | **Target Requests** | Available Targets | LoCoS Datasets | Target BDMs | Target Drawings | Taxon Fields | Part/Type Lists | SBAC/CMT Lists | Capsule Inventory

PORT Home > Targets Home > Target Requests > Request Form > **Target Request**

Target Request

Request #: 14_0012

- Requesting Site: LLNL
- Request R: fobey1
- TF Engineer: fry12
- Expected FLIP ID: LTHD_KeyStag_AAA
- Target Type: [dropdown]
- Positioner: CryoTarpos
- Need Date: 01-AUG-2014

Intended Special Materials

Created: CHOATE3 - 03/19/2013 02:06 PM
Modified: CHOATE3 - 06/03/2015 01:12 PM

Delete this request? No

Target Request Attachments

no data found

Target Features

- Capsule Type: [dropdown]
- Hohl Material: Au
- Hohlraum Diameter: [dropdown]
- [dropdown]
- LEH Size: 3.101
- Tent Thickness: na
- Starburst: Yes
- HDC Window Au Coating: Yes
- Backlighter Mat: [dropdown]
- Factory: [dropdown]

Other Features: Spherical stepped Au later at r=500um for shock stagnation measurement

Shot Planner Attachments

no data found

Build Approvals

Actual Materials

Beryllium: [dropdown] Uranium: [dropdown]

Plutonium: [dropdown]

Depleted Uranium: [dropdown]

Tritium: [dropdown] Other Rad: [dropdown]

Deuterium: [dropdown] SM Updated: [dropdown]

TR Status: TFRT Approved Locked: No

Program Approval: 19-APR-2013

R&D Required: [dropdown]

TFRT Required: [dropdown]

TFRT Approval: 19-APR-2013

Goal Date: [dropdown]

Hold Date: [dropdown]

Approver: [dropdown]

Comments: [text area]

Updated: CHOATE3 03/23/2014 11:22 AM

Build Count: 1

Contingency: [dropdown] wks

FLIP Shot Plan

FLIP ID: [dropdown]

Schedule Date: not in FLIP

Primary1: 36220001

Backup1: NA

Primary2: NA

Backup2: NA - 2 pos shot

Selection: [dropdown]

Comments: [text area]

Updated: CHOATE3 - 07/31/2014 08:36 AM

Build Targets

New SNs are added per the Build Count

Build TR	Target SN	Part Alias	M	Description	TF Engineer	Icd	Glovia Status	Assy WO	SN Status	Ready Date	First Flip Dt	Float	Primary TR	Backup TR	Updated	By
14.0012	36220001	3622		-	fry12	46	Inventory B298R111	PTRG144238	RVP	06/09/14	-	-	14.0012	-	06/02/2014 05:21 PM	CHOATE3

(use the SN link for deletes)

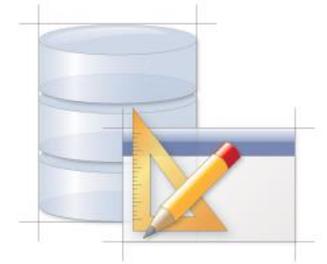
Display of duplicate data

Hard-coded features prevent readily adapting to new engineering processes

Overly complicated logic for sourcing data that slowed the page load time

Limitations of former Target Request tool

- Former target request application developed in Oracle Application Express (APEX) had multiple limitations.
- Process and user interaction limitations:
 - Engineering processes evolved making existing user interaction out of date.
 - Underlying data architecture was not optimized for current use.
 - Development over time led to inefficient use of data.
 - Page loading times were very slow.
- Technology limitations:
 - Customization was possible within the limitations of the APEX framework.
 - All development had to be done through the APEX Web interface.
 - There was no built-in version control.
- Decision was made by the Shot Data Systems (SDS) team to develop a new application, with new technologies and on a new data model, rather than modifying the existing one.



ORACLE[®]
Application Express

New Target Request Tool (TRT)

The screenshot displays the TRT interface with the following sections:

- Target Order:** TR # 2497, Rev 4, Primary/Backup TR Pairings, Requestor schneider5, Order Date 06/13/2017.
- Target Features:** Do you want to populate the target features menu by searching the target catalog or by copying an existing TR? (Select Value), SM Copied From 48160003, PM Copied From 1021516040, TR # Copied From 3761527, Target Platform Cypn, Sub-platform Cypn.
- Target Status:** Transition TR Status (Select Value), TR Status Approved, TR Status Date 09/13/2017, Target Fab Engineer h481, Target Designer h481, Draw Release Date 09/07/2017, Issue Step, Target Ready Date 10/04/2017, Target Flight 29, Target Part No. 1002816000, Target Serial No. 5117001, Target Drawing Tower (Sym-36, 215_Au_540_1013_3M, HCG:NA:NA, UNCDPFG:444, 64_T_1002816000), Target Factory 8381.
- Shot Pairing:** FLIP ID Fa_Diag_SymCCDO_SpecPQ_AAA, Other TRs Linked to FLIP ID: No Other Pairings were found, Goal Date (optional), Shot Date (FLIP) 11/02/2017, Shot Date (FLIP Proposed) 11/02/2017.
- Target Configuration:** Primary Positioner Tm, Secondary Positioner NA, DM 90-78 Instrument DISC3, DM 90-124 Orientation Horizontal, DM 90-124 Instrument NA, DM 90-124 Orientation NA, DM 90-315 Instrument DISC2, DM 90-315 Orientation Horizontal.
- Experimental Team:** Institution LLNL, Campaign Abbr Dmg, Campaign Lead schneider5, Alternate Campaign Lead, Shot ID schneider5, Project Engineer ehsh1, Supporting IS 1, Supporting IS 2.
- Target Area Data:** Shot Type C, Target Shot Temperature 80, Hohlraum FB h48, Capsule Fill C2 + Krypton, Hohlraum Pressure Standard, Capsule Pressure Standard, Backlighter FB NA, Backlighter Pressure NA, Target Gas Fill Description, Intended Special Materials None.
- Menu Options:** All yellow and red triangles indicate invalid feature values that must be updated prior to submitting the TR. To Modify these menu options, please select Yes. Do you want to update menu features? when available. Target Type Sym-09-315, Positioner Tm, Scale 540 1013, Hohl Mod Au, LEIR Insert 3.449, Capsule HCG:NA:NA:UNCDPFG:444:64, Upper Tent 45, Lower Tent 45, Fill Tube Size 10 um, Starboard No, RCP Coating Yes, DB Window Coating No, Slats No, Core Coating NONE, Backlighter NA, Air Thickness NA, Heat Switch No.
- Shot Charge Requests (SCRs):** Table with columns SCR No. and SCR State.

SCR No.	SCR State
2029	CLOSED
2092	DRAFT
2318	CLOSED
2374	OPEN
- Target Pairing:** FLIP IDs Paired to TR: Table with columns TR Num, FLIP ID, TR State.

TR Num	FLIP ID	TR State
2497	Fa_Diag_SymCCDO_SpecPQ_AAA	primary

 TRs Paired to Selected FLIP ID: Table with columns TR Num, FLIP ID, TR State.

TR Num	FLIP ID	TR State
2497	Fa_Diag_SymCCDO_SpecPQ_AAA	primary
- Comments Log:** schneider5 06/13/2017 15:58: HCN:KSCM: special WINCOWS for 90-78 and 90-315. I enclose a picture we have talked to Jeremy KOF about the Capsule Fill is different. C2 = 2.00% or (or close to this).
- Attachments:** 1 linked to TR.
- Target Request:** SymCCDO_SpecPQ_20170902.pdf

Display of common data

Customizable features that allow for readily adapting to new engineering processes

Simplified logic for sourcing data that improves page load time

Displayed here is the full view of TRT composed of 3 columns that are gradually displayed as the user makes his/her selections

Zoom in view of two top panels of TRT's left column

NIF Target Orders > Requester Page

Remember to press SAVE to update the database with any data entered on this page including comments.

Find TR by Number

Target Order

TR # 2497
Rev 4
Primary / Backup TR Pairings [See Target Pairing Panel on the right](#)
Requestor schneider5
Order Date 06/13/2017

Shot Pairing

FLIP ID Fa_Diag_SymCDD_SpecPQ_AAA

Other TRs Linked to FLIP ID No Other Pairings were found

Need Date (optional)

Shot Date (FLIP) 11/02/2017
Shot Date (FLIP Proposed) 11/02/2017

Sequence of steps to create a target request

1

New target request
Left panel is displayed

2

Select FLIP* ID

3

Data related to FLIP ID is populated

NIF Target Orders > Requester Page

Remember to press SAVE to update the database with any data entered on this page including comments.

Cancel Save Submit Copy Find TR by Number go

Target Order

TR #
Rev
Primary / Backup TR Pairings See Target Pairing Panel on the right
Requestor man1
Order Date

Shot Pairing

Scheduled in FLIP or FLIP Proposed?

NIF Target Orders > Requester Page

Remember to press SAVE to update the database with any data entered on this page including comments.

Cancel Save Submit Copy Find TR by Number go

Target Order

TR #
Rev
Primary / Backup TR Pairings See Target Pairing Panel on the right
Requestor man1
Order Date

Shot Pairing

Scheduled in FLIP or FLIP Proposed? Yes RESET

FLIP ID

- Select Value
- D_Astro_ARC_PairPlan_AAA
- D_Astro_ARC_PairPlan_BBB
- D_Astro_BField_LDMag_AAA
- D_Astro_BField_LDMag_BBB
- D_Astro_Catloc_ACSEL_OGG
- D_Astro_Catloc_ACSEL_HHH

NIF Target Orders > Requester Page

Remember to press SAVE to update the database with any data entered on this page including comments.

Cancel Save Submit Copy Find TR by Number go

Target Order

TR #
Rev
Primary / Backup TR Pairings See Target Pairing Panel on the right
Requestor man1
Order Date

Shot Pairing

Scheduled in FLIP or FLIP Proposed? Yes RESET

FLIP ID

Other TRs Linked to FLIP ID
2630, 2676, 2673, 2464, 2476, 2475, 2474, 2472, 2383, 2395, 2390, 2389, 2390, 2387, 2388, 2295, 2295, 2241, 2222, 2227, 2201, 2200, 2198, 2152, 2095, 2036, 636.0001

Need Date (optional)

Shot Date (FLIP) 6/12/2017
Shot Date (FLIP Proposed) 6/16/2017

Target Configuration

Primary Positioner CDS
Secondary Positioner NA
DM 90.78 Instrument FCXCAF
DM 90.78 Orientation Vertical
DM 90.124 Instrument NA
DM 90.124 Orientation NA
DM 90.215 Instrument NA
DM 90.215 Orientation NA

Experimental Team

Institution LLNL
Campaign Astro
Campaign Lead 080606
Alternate Campaign Lead 080604
Shot ID 080606
Project Engineer ckr201e1
Supporting RI 1
Supporting RI 2

Target Area Data

Shot Type W-B
Target Shot Temperature Room Temp
Hohlraum FIB NA
Capsule FIB NA
Hohlraum Pressure NA
Capsule Pressure NA
Backlighter FIB Ch3 50/50 atomc
Backlighter Pressure 10 ATM
Target Gas FIB Description
Intended Special Materials None

*FLIP = Facility and Laser Integrated Planning

Sequence of steps to create a target request (continued)

4

Select how to obtain target features

Target Features

Do you want to populate the target features menu by searching the target catalog or by copying an existing TR? Select Value -

Select Value -

Yes, search target catalog

Yes, copy existing TR

No

Attachments

Upload to TR

Target Request

Shot Planner



5

Target features are loaded into the middle column

Target Features Menu

Do you want to populate the target features menu by searching the target catalog or by copying an existing TR? Yes, search target ... RESET

TR# 43270002

SN Copied From 1000045236

PN Copied From 674.0002

TR # Copied From 674.0002

Target Platform Copy

Sub platform Copy

Crjye Feature Selection Menu

Do you want to update menu features? No

Variation Degree Exact Duplicate

Menu Options

All yellow and red triangles indicate invalid feature values that must be updated prior to submitting the TR. To Modify these menu options, please select Yes for 'Do you want to update menu features?' when available.

Target Type THD-75-50

Positioner Cps

Scale 609.026

Host Mat Au

LEH Inset 2.101

Cartridge CHANA THD-1.205-75-108

Upper Test 30

Lower Test 30

Fill Tube Size Select Value -

Startured Yes

HDC Coating Yes

DI Window Coating Yes

Burnt Yes

Cone Coating NONE

Backlighter NA

Ice Thickness TBD

Heat Switch No

Comments Log Click to make sure this is TO for subuser

Backlog Target Edit

Add Comments

Attachments

6

TR can be saved. TR# is generated

Action buttons (save, submit, withdraw, cancel)

NIF Target Create - Responder Page

Do you want to populate the target features menu by searching the target catalog or by copying an existing TR? Select Value -

Select Value -

Yes, search target catalog

Yes, copy existing TR

No

Attachments

Upload to TR

Target Request

Shot Planner

Business Status Your Target Request has been created

Cancel Save Submit Withdraw Cancel

Cancel TR by Number

Target Order

TR # 2001

Rev 1

Primary Backup TR Package See Target Flaring (link in the right)

Response: None

Order Date: 20200207

TR # Copied From: 674.0002

Target Platform: Copy

Sub platform: Copy

Crjye Feature Selection Menu

Do you want to update menu features? No

Variation Degree Exact Duplicate

Menu Options

All yellow and red triangles indicate invalid feature values that must be updated prior to submitting the TR. To Modify these menu options, please select Yes for 'Do you want to update menu features?' when available.

Target Type THD-75-102

Positioner Cps

Scale 609.026

Host Mat Au

LEH Inset 2.101

Cartridge CHANA THD-1.205-75-108

Upper Test 30

Lower Test 30

Fill Tube Size Select Value -

Startured Yes

HDC Coating Yes

DI Window Coating Yes

Burnt Yes

Cone Coating NONE

Backlighter NA

Ice Thickness TBD

Heat Switch No

Comments Log Click to make sure this is TO for subuser

Backlog Target Edit

Add Comments

Attachments

Shell Change Requests (CRs)

CR No. CR State

CR # OPEN

CR # OPEN

Target Paring

FLUP IDs Planned to TR

No Submitted TRs were Found

TRs Planned to Selected FLUP ID

TR Num	FLUP ID	TR State
2287	D_Astro_EFwld_LDRng_AAA	backup
2158	D_Astro_EFwld_LDRng_AAA	primary
638 0001	D_Astro_EFwld_LDRng_AAA	primary
2232	D_Astro_EFwld_LDRng_AAA	primary
2393	D_Astro_EFwld_LDRng_AAA	backup

Pop-up menu to select record to copy from

Technologies chosen for the development of TRT

- Node.js
 - Open-source, cross-platform JavaScript run-time environment for executing JavaScript code server-side.
 - Modern technology that is supported by a large community of developers.
 - Suitable for non-CPU-intensive operations.
- Express
 - Open-source, minimal and flexible Node.js Web application framework written in JavaScript.
 - *De-facto* standard framework for the majority of Node.js applications.
- Kendo UI
 - Commercial off-the-shelf library for data-rich Web applications that provides more than 70 reusable UI components.
- JavaScript, jQuery, HTML, and CSS
 - Commonly-used Web technologies that allow for an easy implementation with Node.js as the back-end.

Back-end

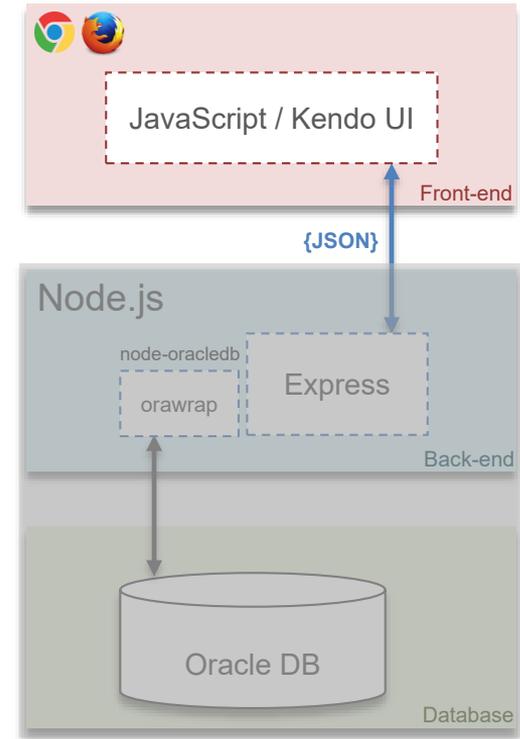


Front-end



Reasons for using chosen technologies in TRT Architecture

- Front-end:
 - Model-view-controller pattern - selected to provide a clear separation between view and logic.
 - Allowed to easily subdivide the UI into multiple sections and panels which in turn provided flexibility to divide the work among developers.
 - Improved performance significantly as it allowed asking the back-end for data only when needed.
 - Simplified the addition of new panels and features to the UI as most panels are independent and do not need to be reworked for accommodating the new panels.
 - Kendo UI – selected to simplify implementation and speed development.
 - Allowed to customize available UI components to the tool's needs.
 - Provided an easy integration with other Web technologies used in the tool.
 - Improved the look-and-feel of the UI with a simple and clean look.
 - JavaScript, jQuery, HTML and CSS – selected technologies to complement the JavaScript-based back-end.



Developed in a standard model-view-controller pattern.

Example of MVC and Kendo UI in a TRT panel

Controller: User's selection drives the display of menu options in the bottom panel

Model: list of values in the dropdown obtained from the object model

View: All dropdowns use Kendo UI

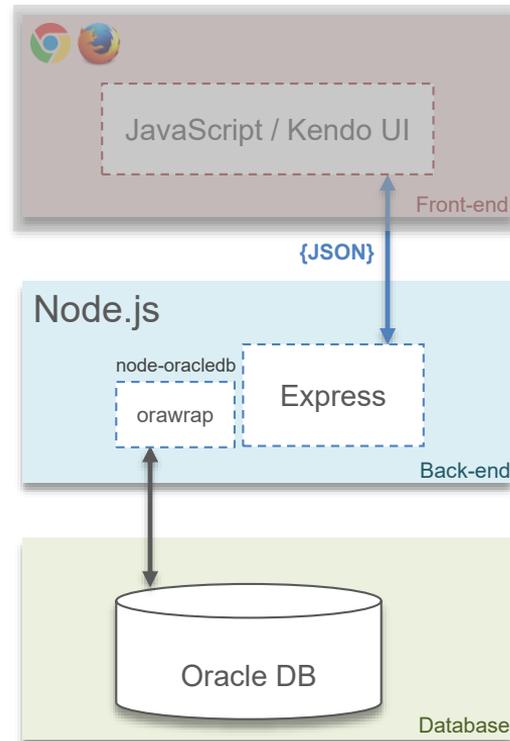
Reasons for using chosen technologies in TRT Architecture (continued)

- Back-end:

- Node.js – has proven to work well and be reliable for other SDS applications.
 - Allowed us to seamlessly connect to existing Oracle database.
 - Provided a fast turnaround for developing the application.
 - Paired well with Web technologies used for the front-end.
- Express – is easy to use and provides a well-written online documentation.
 - Provided multiple methods for querying the request and constructing the result as a JSON file.
 - Provided a thin layer of fundamental Web application features, without obscuring Node.js features.

- Database:

- Oracle database – is the supported infrastructure for the facility and used for all SDS applications.
- 'node-oracledb' driver - manages a fast and stable database connection.
- 'orawrap' library - creates a listening pool on the provided port and provides an easy way to handle SQL queries.
 - *The orawrap library is no longer being maintained. It has been added to the core Oracle database driver (node-oracledb).*



Conclusion

- The use of modern technologies allowed the SDS team to meet the overall project goals primarily within the development time allocated.
- TRT provides faster loading time, improved user interaction, and smooth data integration.
- Future maintenance is simplified given the MVC pattern adopted.

Thank you

