

# Prison reassignment optimization model saves PA estimated \$2.9 million

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A "first-of-its-kind" optimization model developed by engineers at Lehigh's P.C. Rossin College of Engineering and Applied Science is helping Pennsylvania's Department of Corrections (PADOC) streamline the assignment of inmates to the state's 25 correctional institutions.

PADOC officials say the Inmate Assignment Decision Support System (IADSS) has "transformed" the inmate assignment process in Pennsylvania and can do the same for state correctional agencies across the United States. In the long run, they say, the system could shorten prison stays and reduce recidivism—the rate at which released prisoners commit new crimes—by giving [inmates](#) more timely access to the treatment programs they need to earn parole.

There are currently 46,800 inmates in the state's correctional institutions. PADOC's annual expenditures total approximately \$2.5 billion, or about 8 percent of the state's total budget.

IADSS can make hundreds of inmate assignments in a few minutes, a task that requires hours when performed manually by humans. The system is the product of five years of work by graduate students and faculty members in the department of industrial and systems engineering. Its developers say IADSS represents the first application of operations research to the assignment of prison inmates.

PADOC officials have been using IADSS for 10 months to help assign inmates and they plan to switch over to it completely early next year.

IADSS was also used to help reassign 2,000 inmates from the State Correctional Institute in Pittsburgh, which was recently closed, to other state prisons.

In a report released Sept. 1, PADOc officials said IADSS has enabled the corrections department to achieve cost savings and improvements in four areas:

- Shorter waiting lists for treatment programs. This will reduce the length of time inmates remain in prison past their minimum sentence date.
- Fewer prison assaults. This has resulted from an improvement in assigning the right combination of inmates to the right prisons.
- Staffing. Fewer staff members will be needed in the PADOc's Office of Population Management to oversee inmate assignments and transfers.
- Transportation. More inmates are being assigned to the most appropriate institution the first time, reducing the need later for transfers of inmates to other prisons.

"Based on these four criteria," the report said, "we believe that the IADSS has saved the PADOc, and thus saved Pennsylvania taxpayers, approximately \$2.9 million during the first year, which will translate into approximately \$19.2 million in savings over the next five years."

Meanwhile, the group that invented IADSS has been named a finalist for the Daniel H. Wagner Prize for Excellence in Operations Research. The international prize is awarded each year by the Institute for Operations Research and the Management Sciences (INFORMS), the premier professional association for analytics and operations research. This year's prize will be awarded Oct. 24 at the annual INFORMS conference in Houston.

"[IADSS] is the first model of its kind in the nation, and addresses an important problem that all large correctional departments face," PADOCSecretary John E. Wetzel wrote in a letter of recommendation to the Wagner Prize selection committee.

"Every year, my department receives approximately 11,000 new inmates who must be assigned to one of our 25 prisons around the state...[IADSS] has completely transformed our processes and is already leading to significant efficiency improvements and savings.

"I know that my peers around the country who direct other state correctional agencies will also benefit tremendously from [this] model."

The group that developed IADSS is led by Tamas Terlaky, the George N. and Soteria Kledaras '87 Endowed Chair Professor in the department of industrial and systems engineering. The group also includes Lou Plebani and George Wilson, professors in the department; Mohammad Shahabsafa, a Ph.D. candidate; Anshul Sharma, a graduate student; Dan Li '13 Ph.D. and Chatainya Gudapati '17 M.S.

The heart of IADSS, says Shahabsafa, who travels every two weeks to Mechanicsburg to confer with PADOCS officials, is its optimization module, which can assign hundreds of inmates to correctional institutions in just a few minutes. A graphic user interface allows access to information on inmates in the PADOCS database, enables users to review and approve the optimal assignment, and provides several measures to evaluate assignment recommendations.

The optimization module enables IADSS to assign inmates—and to account for a variety of relevant factors—simultaneously, says Shahabsafa. These factors include a prisoner's age, home town, offense, sentencing information, stability level, risk level, minimum and maximum dates of release, and medical and programming needs, as well

the capacity and level of resources available at each institution. IADSS also accounts for inmates' functional limitations—whether they are hearing- or vision-impaired or use a wheelchair, etc.

William Nicklow, PADOA director of population management, says inmates were previously assigned to Pennsylvania's correctional institutions in a sequential process by DOC employees who consider each of these factors for one inmate at a time.

In addition to new inmates, the DOC also oversees the transfer of inmates within the state prison system, says Nicklow.

"Every year, we receive about 50,000 petitions from our correctional institutions requesting a transfer of an inmate. Before the Lehigh model was developed, we looked at each inmate individually and evaluated all the factors regarding that inmate separately. This is a pretty cumbersome process."

In assigning and transferring inmates, says Nicklow, IADSS considers the needs of each inmate and the resources—empty beds, security level, treatment programs and vacancies—that are available at each of the state's correctional institutions.

"The Lehigh model looks at everything simultaneously and holistically. It makes the most appropriate recommendation for everybody based on the resources that are available at that time.

"With the current process, it takes seven people most of a week to do this. Now the whole job can be done with the push of a button, and the outcomes are actually better. We're making better decisions and we're meeting all the requirements for the inmates' assignments."

IADSS has also helped PADOA reduce the time inmates must wait for

openings in treatment programs that they are required to complete to qualify for parole or early release, says Nicklow.

"Our most difficult problem is the treatment program waiting list. The Lehigh model helps us prepare for parole hearings. We like to start programming about 10 months before the minimum sentencing date so that all the programs are completed when an inmate is released, and so that what an inmate learns from a program is fresh in his mind when he is released.

"As a result of the Lehigh model, the start time for entering programs has been decreased. The model will help us make sure that no one starts a program just before their parole. And it will help us avoid having to transfer inmates from one facility to another to get into a program."

IADSS has also helped PADOC reduce human error in assigning inmates, Wetzel wrote in his letter to INFORMS.

"Before we worked with Lehigh University on this project," he wrote, "our internal processes for making these assignments relied on human judgment, and led to many sub-optimal placement decisions."

The industrial and systems engineering department began studying inmate assignments five years ago when Li did an internship with PADOC and developed a decision tree identifying the factors involved in inmate assigning. Li earned her Ph.D. in 2013 and the project was taken up by Shahabsafa.

IADSS, says Shahabsafa, is based on mixed integer linear optimization (MILO), a method that was applied nearly three decades ago to the scheduling of airline crews and in other industries but had not previously been tried with inmate assignments in correctional institutions.

Shahabsafa is writing his Ph.D. thesis on an Air Force-funded project involving structural design optimization.

The collaboration with PADOCC, he says, has been particularly rewarding.

"It has been a great opportunity for me to work on a real-world application. I have been going to PADOCC on a biweekly basis for three years.

"Having spent a lot of time and energy on this project, it is an honor for me to see that the product is being used in the actual daily process of the Department of Corrections and that our paper has been recognized as a finalist for the prestigious Wagner Prize."

Provided by Lehigh University

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