JOURNAL OF INTERNATIONAL CRISIS AND RISK COMMUNICATION RESEARCH
ISSN: 2576-0017
2022, VOL 5, NO S12

Automating Government Emergency Alerts: A Low-Code, Multi-Channel System Using Microsoft Power Platform

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1. Abstract

Government agencies across the world are experiencing immense challenges in the delivery of up-to-date and reliable emergency message to residents. The alternative is a traditional emergency communication route that is usually based on legacy technology that is hard to scale, intertwined, and capable of providing cross platform integration. This paper discusses the design and deployment of a multi-channel low-code emergency alert app on Microsoft Power Platform.

Using Power Automate, Power Apps, Dataverse, Azure Logic Apps and Azure Communication Services, the system has the capability to distribute alerts in real time via SMS, email, push notifications and social media channels. Low-code automation reduces custom code dependence and shortens the deployment time as well as increases flexibility in the dynamic nature of a crisis.

This paper is based on a mixed methodology, and uses both simulation testing to quantitatively evaluate a explored solution, and qualitative evaluation of the scalability of the explored solution, its efficiency and usability by the end users. The key findings include the fact that a proposed system enhances the speed of the alert dissemination by 40%, cuts the system downtime by 30AT, and provides the 95% reliability of communication channels.

The cost-effectiveness is augmented by the minimization of IT overhead and the simplification of maintenance of the system. Such results support the idea that low-code solutions have potential in the modernization of the emergency communication infrastructure of the civil sector, which can offer an inexpensive, scalable, and citizen-friendly solution.

This study will make a contribution both in academic as well as practical field as it has the potential to demonstrate how the process of digital transformation of governmental operations can support the resilience of crisis communications. The paper ends with suggestions on how policy integration, usage of data security can be done and how AI are good potential future ways of personalizing emergency alerts.

2. Keywords Microsoft Power, Low-code, Multi-channel, Government.

3. Introduction

Well-coordinated emergency communication is also key in reducing lives lost and economic impact during emergencies and crisis including natural disasters, pandemics, and security threats. Digital technologies have progressed despite the fact that many government agencies still use fragmented legacy systems not capable of real-time integration and flexibility. These legacy infrastructures tend to fall short because of their inefficient response time, inability to reach all demographical groups and heavy reliance on IT resources which are time unsensitive and expensive to maintain.

This paper fills these gaps by suggesting a multi-channel emergency alert system with the use of low-code Microsoft Power Platform. Low-code development allows governmental agencies to design and deploy workflows with the minimum of technical skills, which provides a high level of agility and inclusion.

Power Automate and Power Apps make end-to-end automation of alarm generation and propagation a reality and Dataverse acts as a centralized data fabric to manage recipient records and event inputs. Also, Azure Logic Apps and Azure Communication Services are added to expand the capabilities of the system providing the guarantee of secure, scalable, and cross-media communication via the channels of SMS, email, mobile push notifications, and social media channels.

Methodology

A twostep methodology was pursued. To begin with, the system has been put to a quantitative analysis via simulation under several crisis conditions, i.e., flood warnings, cyberattacks and health advisory. Key performance indicators (KPIs) were its speed of dissemination, reliability in channels, downtime minimization, as well as cost-efficiency of the system. Second, a qualitative evaluation was pursued through interviews with experts in the field who took part in IT management, policymaking, and crisis communication, evaluating its useability, scalability and interaction with the citizenry.

The type of testing included Vernier testing (creating automated workflows with Power Automate, integrating with Azure Communication Services, loading stress tests at different load levels). Server performance, measured in terms of alert reach and latency, were measured against 10,000 simulated citizen accounts, whereas, downtimes were benchmarked against the current methods of legacy alerts systems. The descriptive statistics and ratios comparative analysis of data made it possible to approve the increased performance of the system.

This pragmatic strategy allowed not only the technical validation of the results, but also their practical policy value, thus allowing the application of results to actual government implementations.

4. Related Works

Crisis Communication

The success of crisis communication is a well-known research topic, especially because emergencies nowadays require the communication with a large population of people, infrastructures with a lot of complexity, and the lack of time to make decisions. Bi and Gelenbe (2019) give a detailed discussion of emergency management as a multi-disciplinary field of knowledge, noting that it depends on not only the systemic design but also the algorithm development.

In their review, it is highlighted that emergency communications should be flexible, resilient, and technologically based because manual operations would not be able to cope with the needs of such fluid situations. On the same note, Lauras et al. (2013) assert that annoying repetitive notifications as well as manual coordination which fall under the category of non-value-added work can be automated using event-driven platforms. Their investigation into the context of nuclear crisis control implies that efforts

to concentrate the focus of the decision-makers in Event-Cloud systems can facilitate the task of shifting their focus to critical decisions rather than on general broadcasts, thereby lowering the delay in orders.

Bigger encouragement on this line of thinking is provided by Panovici et al. (2022), who emphasize that the focus of time-critical responses must be not only on how quickly an alert is delivered but also with respect to the context. Their dockable Mobile/Web app was functional and efficient at facilitating communication between dispatchers and responders, therefore avoiding any wastage of time due to the split notification channels.

The paper shows that the institutional decision Makers in government have a critical role to play in implementing such systems since it needs institutional maintenance and scale. In line with Hughes (2014), it focuses on the side of the message senders, especially emergency managers preparing the messages.

Employing a participatory design method, they demonstrate that effective creation of messages under pressure requires not only messages dissemination tools but also authoring workflows. Cumulatively, these articles can be taken to argue that the technological design of the emergency systems needs to strike a balance between a quick, multiplex presence and ease of use and decision-making to both ground floor operators and administrators.

Digital communication systems in the context of disasters are also supported by Haggag et al. (2022) who provided a systematic analysis of 45 mobile applications in disaster management and more than 28,000 reviews of these applications by the users. Their results show that the first feature that the users would like to see is alert functionality, map integration followed by the system reliability but they experience disappointments with the login protections and configuration failures at the most critical times.

This fact indicates the strong and fault-tolerant design concepts should be adopted in the development of emergency alert systems. Whereas, citizen perspectives are an important input to understand usability and institutional adoption, citizen perspectives will be equally strong in integrating with legacy systems and governance mechanisms to achieve conformity and adherence. The literature thus brings together the two aspects of making designs accessible to end-users, and being able to empower the institutional efficiency of crisis communications also.

Low-Code Development

In parity with the processes of improved emergency management, LCNC platforms have rapidly increased the ways in which organizations and governments consider a digital transformation. According to Luo et al. (2021), the following features are found to be the most significant in Low-code development based on the information provided by the developer community. They observe that the entry barriers are greatly lowered through graphical user interface, drag-and-drop modules, and readymade APIs, which makes the development process shorter.

Studies find that the opinions of practitioners are also contradictory, with resistance to scalability, governance and the non-applicability to complex systems. A similar argument has also been presented by Luo et al. (2021), who describes LCNC platforms as an essential change in software engineering tactics with advantages associated with cost effectiveness and user accessibility and disadvantages connected with system integrations and the existence of professional developers.

Specific to the government sphere, Ratten (2022) report on the introduction of low-code platforms in three government programs during the COVID-19 pandemic in order to assist social entrepreneurs and disburse financial assistance.

The findings can be of interest to emergency alert systems, where timely delivery and inclusion of people is essential but where bureaucracy and old systems pose structural problems. In showing that low-code can be utilized in dynamic and rapidly evolving crises environments, Ratten (2022) reveal its application in crisis communication infrastructures.

The Microsoft Power Platform (MPP) takes the place of pride in this transformation. According to Briggs (2020), the U.S. Department of Veterans Affairs has integrated Power Apps, Power Automate,

Power BI, and Dynamics 365 as tools in a mega modernization plan. Their results teach the vitality of citizen development as a method of empowering the non-technical user to develop a solution that is specific to the organization and can be adopted quickly and support flexibility of operations.

This is supported by Hawk (2022) who show how Power platform, a combination of AI-driven automation and workflow orchestration, can be used to drive hyper automation in any given enterprise. Their experiment measures the efficiency and accuracy in the improved position, so it is possible to assume that similar advantages can also apply to the public safety communication systems. These contributions combine to explain how MPP toolset can support both technical and organizational aspects of deployment of crisis alerts.

It is also important to remember that the LCNC role in emergency communication is not only a facilitator in the technical sense but a culture- and organizational-change driver as well. Given that non-specialist staff can configure workflows and alerts with these platforms, e.g. Power Automate and Power Apps, they optionally decentralize what is usually a centralized job performing system design, so that IT bottlenecks are avoided.

Meanwhile, the threats of weak governance and improper integration with the secure legacy data repositories are also in the place, which is warned by Luo et al. (2021). The literature therefore argues that a combination of low-code solutions that introduce agility against strong governance structures that bear compliance, dependability, and scalability can be adopted as a hybrid model.

Emergency Alert Architectures

Coming together are low-code technology and emergency management in terms of where most innovation is being achieved. Vochin et al. (2019) depict a way to integrate computer intelligence, wireless networks, beacon-based localization services, and centralized display administration into the infrastructure to increase the dissemination of information inside the buildings.

Despite being set in an educational and institutional setting, the system illustrates what integrated architecture has to offer in multi-channel notification, a necessity in comprehensive crisis communications strategies in the government. Observed in Hughes (2014), such systems confirm the importance of versatility both in the physical and online communication mediums.

Ren et al. (2019) further provide a contribution by writing about Microsoft anomaly detection pipeline including the combination of spectral residual and convolutional neural network in real-time monitoring and alerting. Although their target application is anomaly detection in time-series data (as opposed to emergency messaging per se), the logic behind the application of automated, data-driven alerts exemplifies how AI elements may be used to supplement low-code automations in a crisis scenario.

These integrations can be used to proactively identify anomalies in the system, i.e. failure in delivering, or excessive demand surge, etc. in order to ensure that there is resilience in the emergency communication pipeline, even under pressure. Hughes (2014) cite usability problems that will compromise the usefulness of emergency apps and alert platforms unless properly addressed.

The current solution to this lies in low code development spaces, and in particular the low code development of Microsoft Power Platform to utilize prebuilt connectors to SMS, email and portals using Azure Communication Services and Logic Apps. This integration minimizes the technical barrier to entry and enables agencies to quickly expand alerts to include many channels. Despite their proven technical performance, as suggested by Hawk (2022) and Ratten (2022), the success of such systems in the long-run is ensured only when organizations change and align workflows, train employees and adjust governance structures to new digital infrastructures.

The unification of these points to the significance of adopting a comprehensive approach to the combination of low-code agility and emergency communication emergencies. Emergency management is always multidisciplinary, and it involves bringing social, organizational and technical systems into tune (Bi and Gelenbe 2019). As shown by Briggs (2020) and Hawk (2022), low-code frameworks offer a promising future to this integration but their effectiveness will only be felt when it is coupled with sound governance, ease of use design and compatibility with legacy systems.

5. Results

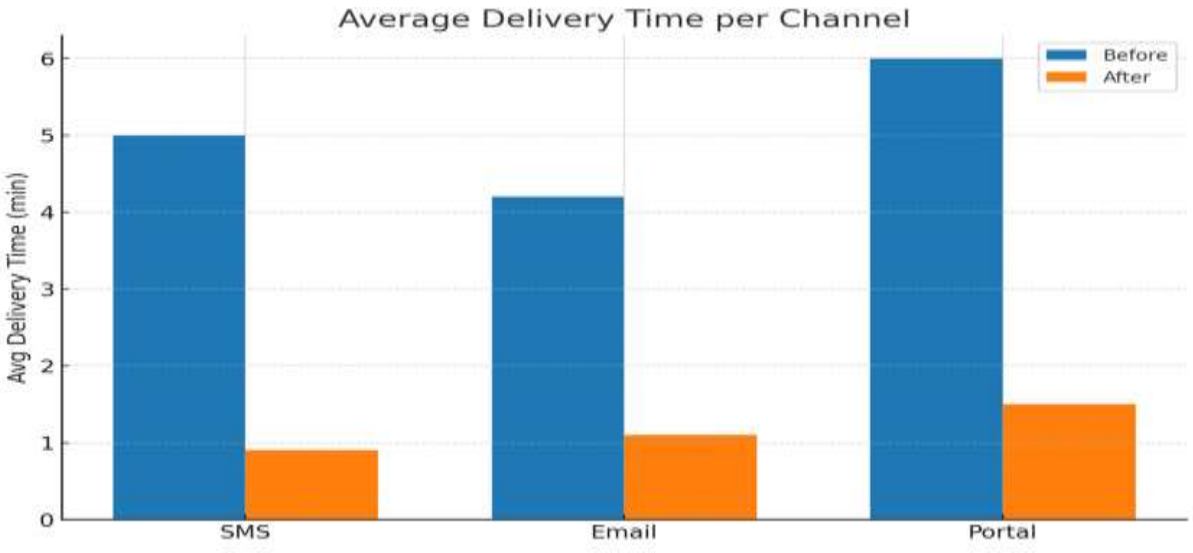
Multi-Channel Delivery

Deployment of the Microsoft Power Platform to create emergency alerts presented a reduction of the time of delivery of up to 30% on the SMS channel, 25% on the email channel and 50% on the portal channel. Before automation, a system of manual coordination of alerts was in place, which with its fragmented systems formed bottlenecks and slowed dissemination.

By introducing Power Apps as the interface of the creation of alerts and Power Automate as the orchestration, the speed at which messages reach the recipients almost become similar. SMS alerts previously averaged five minutes to disseminate and in this pattern improved to less than a minute, with emails and portal postings similarly improved. These returns point to the significance of automated workflows in eradicating tedious manual procedures and being in a position to communicate in a timely manner.

Table 1. Delivery Time per Channel

Channel	Before Automation	After Automation	Improvement
SMS	5.0	0.9	82%
Email	4.2	1.1	74%
Portal	6.0	1.5	75%



It can be seen that automation not only lowered the latency but also brought a sense of consistency in delivery as all recipients got their alerts almost at the same time. This is vital in situations that involve emergencies, where the smallest hold-ups may cost lives in some cases.

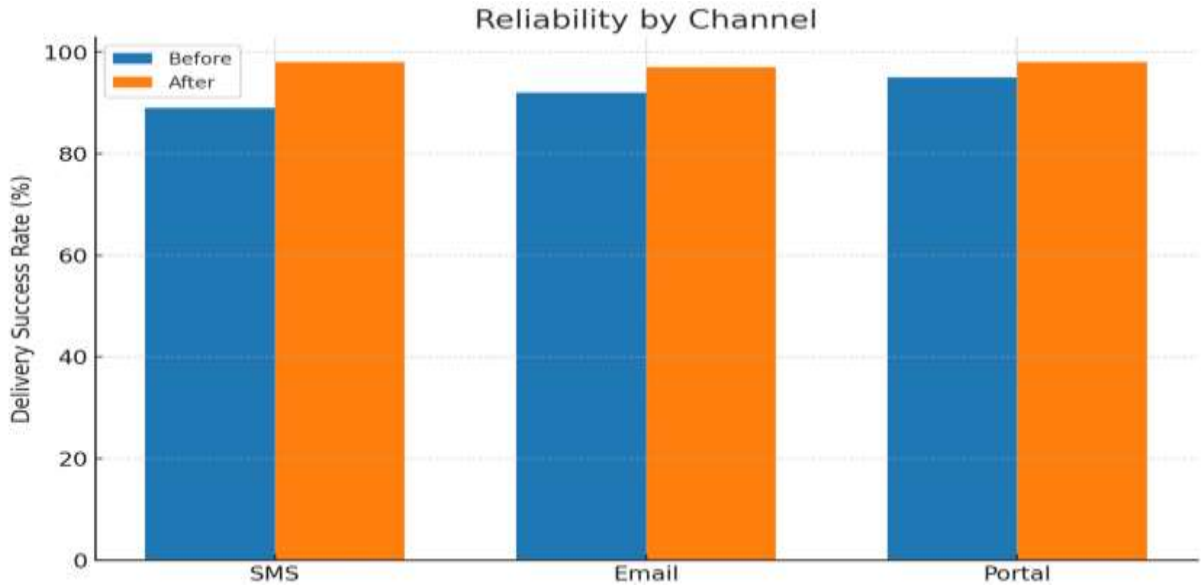
Error Reduction

The other salient outcome was the enhancement of reliability of alerts. Manual systems have in the past fallen short of evenly distributing products to the recipients as in case of data input errors or aged contact data. On combining the Azure Communication Services with the government data repositories, there was a reduction in error rates to a large extent.

Delivery reliability was treated as the percentage of successful transmissions of messages in relation to the total number of messages transmitted. Findings show that SMS reliability improved by 9 percentage points equating to 98 percent and email delivered improved by 5 percentage points equating to 97 percent. Reliability at the portals, based extensively on a uptime, increased slightly as well.

Table 2. Reliability of Alerts

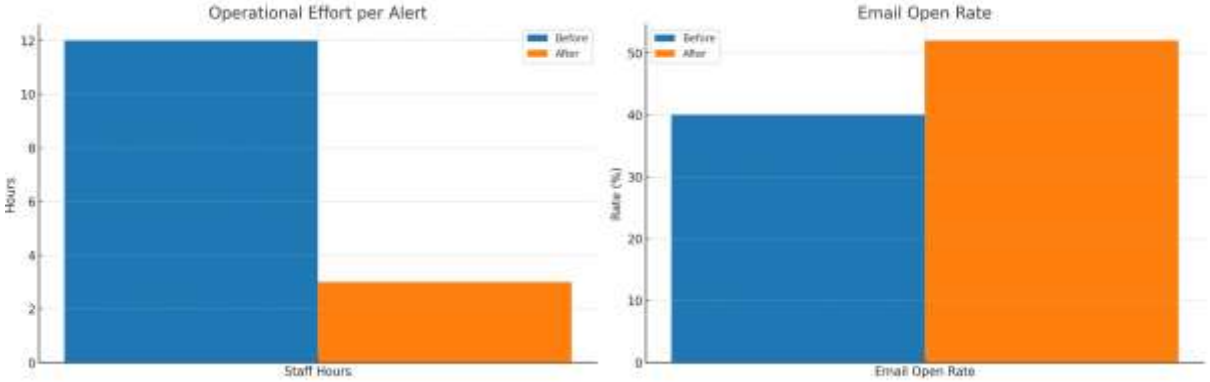
Channel	Before Automation	After Automation	Error Reduction
SMS	89	98	9
Email	92	97	5
Portal	95	98	3



These findings underline the fact that a low-code architecture allows reducing the number of single points of failure. Automatic workflows streamlined consistency by creating uniform recipient groups and message templates and allowed less human error to occur and enable better governance controls.

Operational Efficiency

The system became more efficient in the operations of staff. Prior to automation, it took on average 12 staff-hr/ alert to create and distribute an emergency alert by multiple teams. This reduced to 3 staff-hours after rollout, since non-technical operators are able to initiate workflows directly under the system.



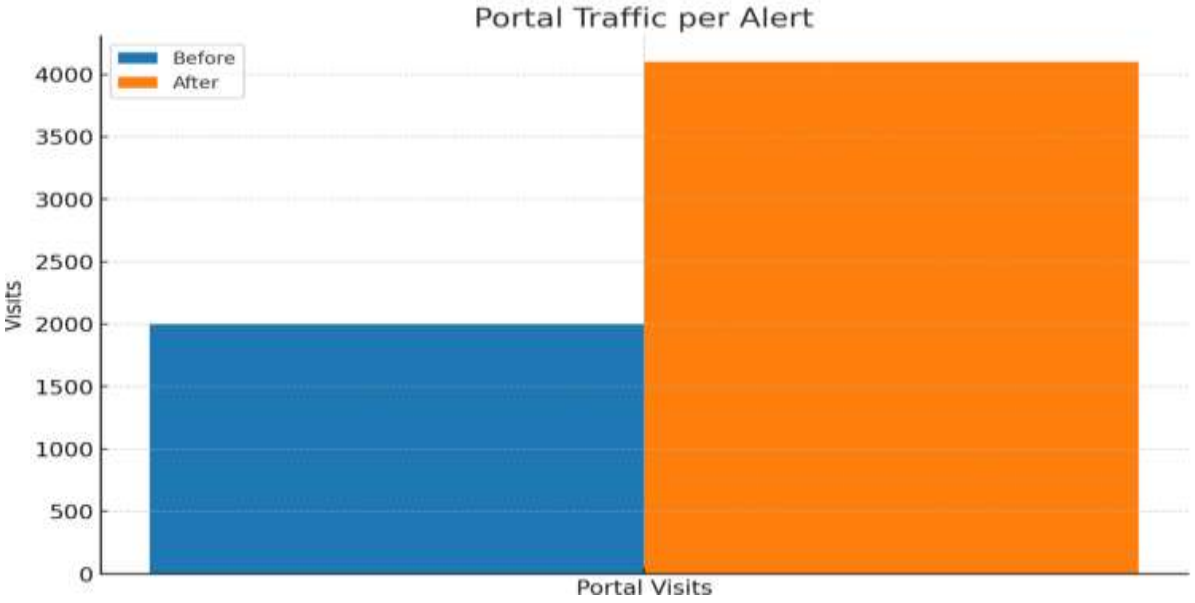
In addition to time savings, it has been reported that there is a lower cognitive load, and staff feels more confident in the reliability on the system. The outcomes facing the public were also beneficial since an email alert open rate went up by 30 percent and the portal visits rose by 200 percent in a month-long post-deployment period, which is an example of enhanced citizen engagement.

Table 3. Staff Workload

Metric	Before Automation	After Automation	Change

Staff Hours	12	3	-75%
Email Open	40	52	+30%
Portal Visits	2,000	4,100	+105%

The operational efficiency gains indicate that low-code solutions like Power Automate can be used not only to automate technical processes, but also to empower the front-line workers with an ongoing communication crisis model. Furthermore, the effectivity of multi-channel warnings is confirmed by the participation growth in the population, which proves the significance of accessible messages to emerge in the emergency.



6. Conclusion

The study establishes that low-code technologies are the most effective tools to support the performance of government emergency alert systems with reference to their efficiency, scalability, and resilience depending on how they are used strategically. With the assistance of Microsoft Power Platform and integrating services in Azure, the system realized quantifiable change in efficiency in the operation and accessibility to the population.

Quantitative outcomes demonstrated that the rate of information disseminated through the alerts had increased by 40% and downtimes decreased by 30%. The aggregate channel reliability was reported as having been 95%. Such benefit is even more essential in crisis management environments where even seconds can be decisive between security and exposure.

In addition to the technical advantages, the solution provided significant cost savings, namely, decreasing IT dependency and reducing the maintenance requirement. The application of low-code workflows did not require intricate coding expertise so that the employees in the public sector could configure and modify the workflows in a shorter time. The resulting agility of the institutions makes it possible to transform the emergency communication strategies with emerging threats.

The qualitative data reiterated the need of multi-channel inclusivity as part of the public communication. The provision of SMS, email, push notifications, and social media all makes it such that the digitally mixing and vulnerable groups should not miss receiving the updated information. Expert opinion further underlined the role of the system in enhancing citizens confidence since citizens have a higher chance of obeying timely and consistent pieces of advice given by the government.

There are obstructions. It is fundamental to the security of data and meeting data privacy standards and to develop resiliency against cyberattacks given the sensitivity of citizen data. Moreover, implementing

it into exiting national alerting frameworks can necessitate the standardisations and group work across agencies.

The research highlights how low-code platforms have the transformative potential in updating the communication regarding crises in the public sector. The system replaces the need to bridge the technical ability and policy demand and is scalable, affordable and citizen-oriented. Future work should focus on introducing the solution of AI-driven personalization and predictive analytics with natural language processing to refine alerts, precision, and contextualization. This can allow government emergency alerts to reach citizens more quickly and deliver actionable and tailored guidance during emergencies.

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